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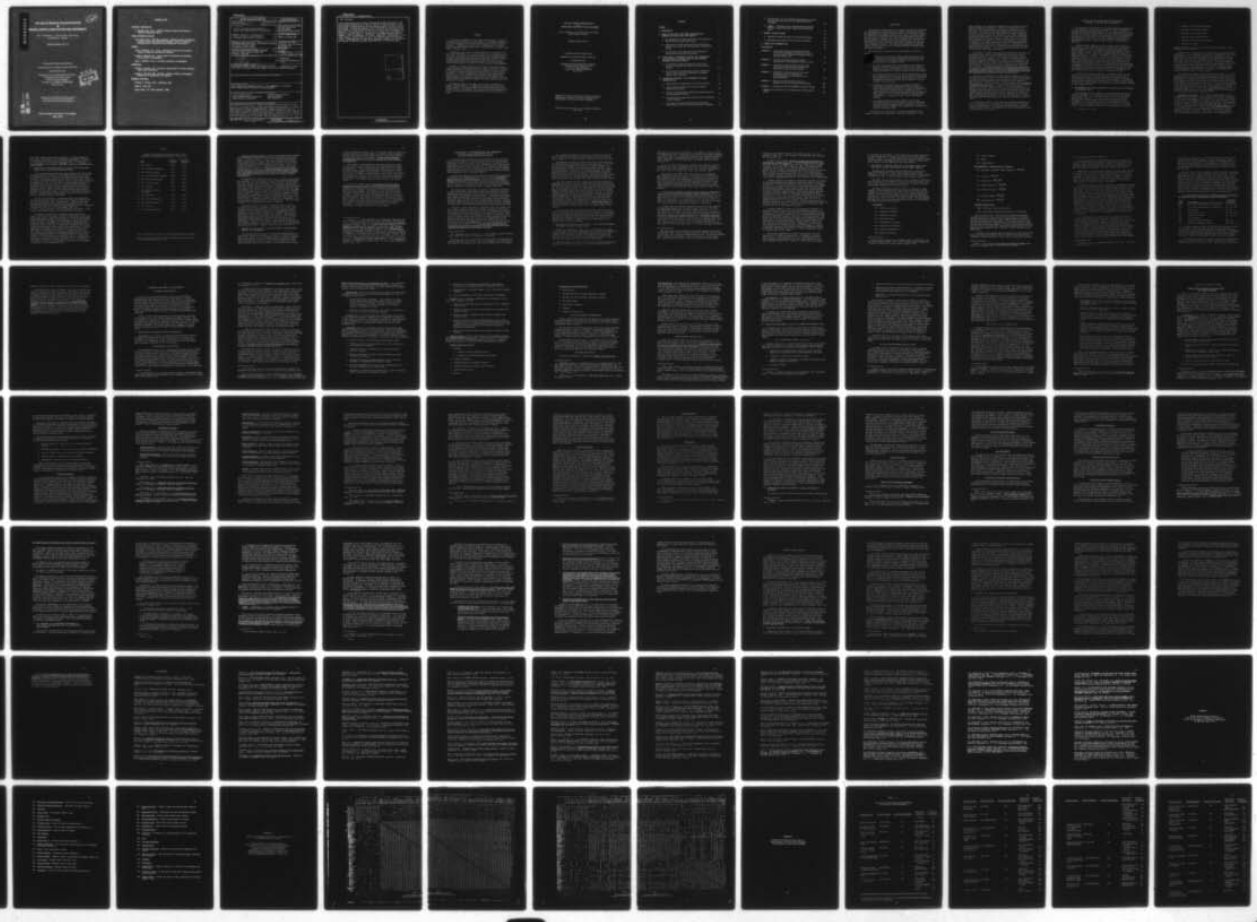

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THE USE OF WORKER CHARACTERISTICS IN MARINE CORPS CLASSIFICATION AND ASSIGNMENT

Paul V. Washburn, C. Harold Stone, Dale Yoder
and William T. Farrell

Technical Report No. 13

A Research Project Supported By

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California State University, Los Angeles
May, 1976

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This research was designed to explore the possibilities of acquiring greater benefit in the areas of Marine Corps classification and assignment by utilizing data collected on worker characteristics. Primary attention is given to measurements of physical demands and environmental conditions of jobs that are not readily measured by objective aptitude tests. Reviews are made of earlier data collection by the Marine Corps using task inventories, and to the research of other organizations in this area. Data are presented concerning the →

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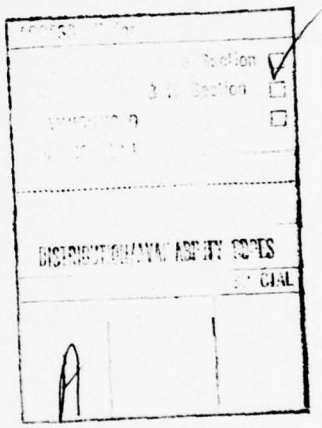
relationships among earlier worker characteristics data collected by task inventories and aptitude test results. The use of aptitude tests in the Marine Corps to select Marines for specialized training in service schools is analyzed. Statistical studies of test validities for selection of both Navy and Marine Corps enlisted personnel for service school attendance are described. An important part of this report is devoted to a discussion of Hanman's "specific method" for appraising the physical and environmental demands of jobs and assessing the physical capacities of individuals to meet those demands. Instructions for use of the specific method are given in detail. Recommendations are made about personnel research, test validation, and methods of appraising worker characteristics in the Marine Corps.



SUMMARY

The research described in this report was designed to explore the possibilities of acquiring greater benefits in the areas of classification and assignment by utilitzing data gathered on worker characteristics. Primary attention is given to measurements of physical demands and environmental conditions of jobs that are not readily measured by objective tests.

Reviews are made of earlier data collection by the Marine Corps using task inventories, and to the research of other organizations in this area. The results of statistical studies are presented showing the relationships among earlier worker characteristics data collected by Marine Corps task inventories and aptitude test results. It is concluded that decision of the Marine Corps to delete self-report worker characteristics items from its task inventories was appropriate.

Results of studies of aptitude tests used by the Marine Corps to select Marines for specialized training in service schools is reported. Statistical data are provided about test validities for the selection of both Navy and Marine Corps enlisted personnel for service school attendance. A major recommendation resulting from these studies of aptitude tests is that the Navy and the Marine Corps should place greater emphasis upon personnel research and test validation, and they should provide more substantial support for such activities than they have done in the past.

An important part of the report is devoted to a discussion of Hanman's "specific method" for appraising the physical and environmental demands of jobs and assessing the physical capacities of individuals to meet those demands. The specific method is recommended for trial in the Marine Corps, and instructions for its use are given in detail.

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I

INTRODUCTION

This Technical Report describes a study of the possible advantages and disadvantages of expanding the Task Analysis program to provide an assessment of the worker characteristics or qualifications required for satisfactory performance of Marine Corps jobs. The report begins by noting that, for most private firms and establishments that maintain job analysis programs, one of the key goals is the discovery and identification of the required personal qualifications for each job as a basis for the most effective selection, placement, and utilization of manpower resources. The required characteristics typically become an important part of the "job specifications" produced by the job analysis program.

The more specific objectives of our study may be outlined as follows:

1. To discover and report the probable usefulness, value, and contribution of a systematic assessment of required worker characteristics for improved management and utilization of human resources in the Marine Corps.

2. To review and appraise the earlier Marine Corps program of using its "Worker Characteristics Inventory" as a means of identifying the personal characteristics required for satisfactory performance in a variety of Marine Corps assignments.

3. To describe and evaluate current Marine Corps practice in the use of aptitude tests as part of the procedure for identifying the qualifications of individual Marines and the use of this information to improve selection and assignment to various technical service schools.

4. To discover and describe several alternative methods of generating and reporting dependable data with respect to worker characteristics required for satisfactory performance of the jobs to which Marines may be assigned. And, to suggest guidelines for instituting a Marine Corps program for this purpose -- i.e. the identification of required worker characteristics, possibly as a part of the Task Analysis program.

5. To recommend and describe what appears to be the most promising procedure for this purpose, noting its advantages and limitations, and suggesting, in some detail, how that procedure could be adapted to and tailored for the distinctive needs of the Marine Corps.

Job analysis has traditionally included an assessment of the worker characteristics required for effective performance of tasks.

Until recently, this function was undertaken in the Marine Corps by asking selected job incumbents to rate such characteristics in a list, the "Worker Characteristics Inventory", according to their opinions of the extent to which each characteristic was required in their jobs. The Inventory was administered to a sample of Marines in each Occupational Field (OF) studied, by the Office of Manpower Utilization, HQMC (OMU) as a part of its task analysis inventories. These responses were suspect, however, because they were not based on observation and analysis by trained job analysts or the results of objective tests, which represent the more traditional approaches to determining required worker characteristics. Furthermore, no pressing need was found for use of the data obtained from the Worker Characteristics Inventory. Its administration was discontinued at about the time this study was initiated.

An analysis of worker characteristics required for effective job performance can be useful for developing job specifications and training programs, for effective selection and placement, and may be helpful for other purposes. But a number of questions must be answered regarding the methods used to collect this information, the resources needed for the process, and whether the responsibility for assessing these characteristics should be assigned to the OMU staff. Our studies in this research area were designed to seek answers to these questions. The basic objective of this research, as specified in the Marine Corps Study Directive, was to explore the possibilities of acquiring greater benefit in the area of classification and assignment utilizing data collected on worker characteristics.

Our report is organized into five sections, beginning with this Introductory section. Section two evaluates the former Worker Characteristics Inventory included in earlier Marine Corps Task Inventories and includes an examination of data obtained from two inventory administrations. The third section describes studies of the validities of aptitude test batteries used in selecting Navy and Marine enlisted personnel for service school training. In the fourth section, a number of alternative methods of assessing worker characteristics are discussed, and a selected review of relevant literature is given with comments about implications for practice. Nine uses for valid information obtained through analysis of worker characteristics requirements are suggested, along with a list of considerations in choosing the appropriate assessment method for specific applications or objectives.

Section Five provides a description of a method recommended for use by the Marine Corps, including its limitations and its expected values and usefulness in classification and assignment. The final section briefly explains and summarizes the eight recommendations made in other parts of this report.

II

REVIEW OF THE USE OF THE WORKER CHARACTERISTICS INVENTORY IN MARINE CORPS TASK ANALYSIS

The purpose of this section is to review findings from administrations of the worker characteristics inventories that were formerly included in Marine Corps Task Inventories. As noted, traditional job analysis has included the assessment of worker characteristics required for effective task performance as an integral part of its methodology for many years. Until early 1974, OMU included a standard Worker Characteristics inventory with its other inventories as part of the task analysis process. A copy of this inventory is reproduced in Appendix A.

Results obtained through the worker characteristics inventory were suspect, because they reflected self-ratings of the mental and physical demands of jobs by incumbents of the occupational fields being studied. That is, each Marine respondent was asked to rate the various characteristics (which also included "emotional stability", "moral courage", "oral memory", "adaptability", and other potentially ambiguous concepts), in terms of the extent to which he felt that the particular characteristic was required in the performance of his job. These assessments, then, were not obtained through observation and analysis by professionally trained job analysts nor through the use of tests, job simulations, or any of the more commonly used approaches. Furthermore, the data about worker characteristics from the task inventory administrations were not used by any Marine Corps agency. These were among the reasons which led OMU to discontinue administration of the inventory at about the time our study was initiated.

One goal of the present study was to determine if there is any valid use or application for data generated by this worker characteristic inventory in its present form within the Marine Corps, or, if an improved version would be potentially more useful. The specific objective was to explore the possibilities of acquiring greater benefit in the areas of classification and assignment by utilizing data collected on worker characteristics.

A. AN EXAMINATION OF WORKER CHARACTERISTICS RATINGS FOR TWO DISSIMILAR OCCUPATIONAL FIELDS

The evaluation of data obtained from the Worker Characteristics Inventory was based upon information supplied by OMU for two Occupational Fields (OFs): OF 33 (Food Services) and OF 70/71 (Aviation Operations/Air Delivery). The data supplied are a representative 10% sample of the total number of Marines who completed the task inventories. The respondents rated each of 58 characteristics with reference to the following question and seven point scale: "To what extent is this characteristic required for performance of your job?"

"1. Required very little

2. Required to a below average degree

3. Required slightly below average

4. Required to an average degree

5. Required slightly above average

6. Required to an above average degree

7. Required very much"

Average ratings for each worker characteristic were computed. These results are shown in Table 1.

Marines in OF 33, Food Services, rated many of the characteristics as important in the performance of their job. Approximately 43% of the characteristics have an average rating by OF 33 personnel as high or higher than 4.0, indicating "required to an average degree". On the other hand, only one of the 58 traits received an average rating as high as 4.0 from the respondents in OF 70/71. In fact, the Marines in OF 33 rated every one of the traits higher than did Marines in OF 70/71. Clearly, these responses imply that all 58 of the various personal characteristics are more important, or required to a greater degree, in the performance of Food Service jobs than in the performance of Aviation Operations and Air Delivery tasks.

This result was unexpected and is difficult to explain. A review of job descriptions for each area failed to provide any verification or substantiation of this across-the-board difference in the ratings. It seemed much more probable that some of the characteristics would have been judged to be required more often in OF 33 while others would have been judged to be more important in OF 70/71. In fact, the job descriptions suggest that Marines in OF 70/71 would be expected to require most of the technical and cognitive traits in the inventory to a greater degree than those in OF 33. The lack of reasonable explanation for the uniformly higher ratings by OF 33 job incumbents led to the conclusion that the ratings may contain consistent errors.

Evidence of Halo Error. One of the most common forms of error in ratings is "halo", where all of the theoretically distinct dimensions or items receive the same or similar ratings, as if one or two factors in the rater's mind determine all ratings. The usual evidence of halo error is a lack of variability and range among ratings. An examination of Table 1 reveals a range in OF 70/71 ratings of 3.5, from 0.5 to 4.0. In OF 33, the ratings range from 2.6 to 4.8, a spread of only 2.2, out of a possible range of 7.0. Standard deviations for each item (not shown in the table) confirm the appearance of relatively limited variability and this evidence of halo effect. This result suggests that these Marines (especially in OF 33) were not discriminating

Table 1

Average Ratings of the Importance
of Worker Characteristics in Their Jobs
by Marines in Occupational Fields 33 and 70/71

	Worker Characteristic	OF 33* Average Rating**	OF 70/71* Average Rating**
1.	Finger, Hand, Wrist, Forearm Strength	4.6	3.9
2.	Upper Arm Strength	4.0	3.2
3.	Back & Shoulder Strength	3.5	2.6
4.	Leg, Foot, Ankle Strength	4.0	2.7
5.	Work Fast for a Few Minutes	4.0	2.7
6.	Work Fast for an Hour	3.9	1.5
7.	Work Fast for Many Hours	3.6	1.0
8.	Heavy, Tiring Work for a Few Minutes	3.0	1.0
9.	Heavy, Tiring Work for an Hour	2.8	0.7
10.	Heavy, Tiring Work for Many Hours	2.8	0.5
11.	Finger Movement	3.9	2.6
12.	Hand & Arm Movement	3.7	1.9
13.	Foot & Leg Movement	3.9	1.7
14.	Eye-Hand Coordination	4.3	2.9
15.	Foot-Eye-Hand Coordination	3.7	1.9
16.	Move Both Hands Separately	3.8	1.6
17.	Foot-Eye Coordination	3.3	1.4
18.	Foot-Hand Coordination	3.3	1.4
19.	Height	2.6	0.9
20.	Weight	2.9	0.9
21.	Unpleasant Working Conditions	3.7	2.7
22.	Dangerous Working Conditions	3.3	2.9
23.	Good Eyes	4.1	2.9
24.	Color Vision	4.1	1.7
25.	Estimate Size	3.8	0.9
26.	Estimate Number of Objects	3.8	0.5
27.	Estimate Speed	3.1	0.7
28.	Estimate Quality	4.1	1.5
29.	Form Perception	3.5	0.7
30.	Good Hearing	4.1	2.3
31.	Good Smell	4.4	0.9
32.	Touch Ability	4.0	0.9
33.	Muscle Sensitivity	3.6	0.8
34.	Taste	4.4	0.4
35.	Detailed Memory	3.8	2.7
36.	General Memory	4.2	3.3
37.	Oral Memory	4.1	3.3
38.	Written Memory	3.9	2.3
39.	Memory for People	3.7	2.0

*OF 33 - Food Service; OF 70/71 - Aviation Operations/Air Delivery

**Average ratings are based on the seven point scale described on page 3 . Extremes and average are: 1. Required very little, 4. Required to an average degree, 7. Required very much.

Table 1, cont'd.

	Worker Characteristic	OF 33 Average Rating	OF 70/71 Average Rating
40.	Arithmetic	4.7	2.3
41.	Planning Ability	3.9	2.8
42.	Mechanical Ability	3.8	2.7
43.	Oral Expression	3.9	2.3
44.	Written Expression	3.6	1.4
45.	Attention Span	4.0	2.8
46.	Adaptability	3.9	2.4
47.	Decision Making	4.1	2.7
48.	Initiative	4.5	4.0
49.	Tact	3.9	2.7
50.	Personal Appearance	4.6	3.2
51.	Concentration	4.3	2.5
52.	Emotional Stability	4.2	3.1
53.	Deal with Public	3.7	1.4
54.	Teamwork	4.2	3.7
55.	Leadership	4.3	2.7
56.	Dependability	4.8	3.5
57.	Physical Courage	3.8	2.7
58.	Moral Courage	4.1	2.5

effectively among characteristics which are or are not relevant to their jobs. Furthermore, the only available independent criterion for evaluating the ratings, the job descriptions, indicate that most of the ratings for OF 33 reflect "leniency" error, i.e. they are overestimations of the degree to which the characteristics are required.

B. COMPARISON OF WORKER CHARACTERISTICS RATINGS WITH APTITUDE TEST SCORES FOR TWO DISSIMILAR OCCUPATIONAL FIELDS

Test scores for the Aptitude Area Classification Test (AACT) were obtained from OMU for Marines in the samples from OF 33 and OF 70/71. The average test scores for each of the thirteen subtests are shown in Table 2 in separate columns for OF 33 and OF 70/71. These statistics reveal consistently higher average scores for personnel in OF 70/71 as compared to OF 33, for every test. If the presence of these somewhat higher aptitude levels in OF 70/71 reflects higher entrance standards for the field, it would be expected that certain cognitive and mental abilities would be seen as more important in that field, compared to OF 33. Among the worker characteristics that would be expected to have higher ratings in OF 70/71 are arithmetic, mechanical ability, oral expression, general memory, and other characteristics that are logically related to aptitudes.

To test this hypothesis, a correlation matrix was constructed for each occupational field which shows the correlation between each aptitude test and each worker characteristic. These matrices also show intercorrelations among aptitude tests themselves, and intercorrelations among worker characteristic importance ratings. Appendix B contains these data for OF 33, and similar data for OF 70/71. Only significant ($p \leq .05$) correlations are shown. A blank space in the tables indicates a non-significant relationship.

The matrices reveal little correlation among aptitude test scores and the rated importance of worker characteristics for either occupational field. Even where there may be a logical relationship between aptitudes and worker characteristics, no significant correlations were found. For example, no significant relation was found between Arithmetic Reasoning test scores and the rated importance of arithmetic skills on the job. A significant correlation would have implied that people who scored high on that aptitude test, rated the importance of arithmetic skills higher than their coworkers in the same OF who scored less well on the test. Similarily, there was no evidence of a relationship between Mechanical Aptitude scores and ratings of Mechanical Ability, nor between Verbal Test scores and ratings of either written or oral expression skills. Perhaps this should not be surprising because the ratings are not an indication of the extent to which an individual possesses a trait, but only the individual's estimate of the importance of that trait to performance of the tasks in his occupational field.

Table 2

Average Aptitude-Area Classification Test Scores
for Marines in Occupational Fields OF 33 and OF 70/71

	Test	OF 33* Average**	OF 70/71* Average**
1.	VE - Verbal	104.3	108.0
2.	AR - Arithmetic Reasoning	99.9	102.6
3.	PA - Pattern Analysis	99.1	107.9
4.	CI - Classification Inventory	86.0	96.1
5.	MA - Mechanical Aptitude	96.0	104.8
6.	ACS - Clerical Speed	101.2	105.3
7.	IN - Infantry	92.6	100.6
8.	AE - Armor, Artillery & Engineer	96.1	104.9
9.	EL - Electronic	83.9	98.6
10.	GM - General Maintenance	85.6	99.1
11.	MM - Motor Maintenance	93.8	105.1
12.	CL - Clerical	95.5	102.2
13.	GT - General Technical	102.4	105.6

*OF 33 - Food Service; OF 70/71 - Aviation Operations/Air Delivery

**All Scores are reported in terms of standard scores with mean = 100 and Standard Deviation = 20.

Evidence of Method Variance. Another interesting pattern emerging from the matrices concerns the intercorrelations among aptitude test scores. A similar pattern is found in the intercorrelations among worker characteristics ratings. The matrices reflect a high degree of significant intercorrelations among the aptitude tests, and high correlations among the worker characteristics ratings. This is especially evident for OF 33. A pattern of this nature is generally interpreted as indicating that a substantial amount of the variance in each variable is associated with the measurement method or instrument. The general conclusion is that there is no consistent pattern of relationships among aptitude test scores and ratings of worker characteristics.

In Appendix B-2, the matrix for OF 70/71, a somewhat more subtle pattern appears in the intercorrelations among worker characteristics. The items fall into two categories. Items 1-34 of the worker characteristics inventory have a high number of significant intercorrelations among themselves but relatively few significant intercorrelations with items 35-58. Similarily, the number of significatant intercorrelations among items 35-58 is very high, visibly higher than the number of intercorrelations with the other characteristics in the inventory. What are these two clusters? The first cluster is composed of physical capacities, psychomotor abilities, and sensory skills, e.g. back and shoulder strength, foot-eye-hand coordination, color vision. The second cluster is composed of cognitive skills and temperaments, e.g. detailed memory, planning ability, and dependability. There are clear conceptual distinctions between these two clusters.

The pattern for OF 33 reflects a different pattern from that in the OF 70/71 matrix. We found it surprising that so many intercorrelations among characteristics from the two clusters appear in the matrix for OF 33 shown in Appendix B. The magnitude of these unexpected intercorrelations appears to be somewhat lower than the magnitude of intercorrelations within the clusters. Nevertheless, this pattern points to the conclusion that Marines in OF 33 did not discriminate among physically oriented worker characteristic requirements and those that are cognitively oriented in relation to job demands. Contrary to the ratings, examination of the job descriptions revealed nothing to indicate that jobs in OF 33 require physical and cognitive skills to a greater extent than jobs in OF 70/71.

C. THE NEED FOR A NEW APPROACH TO THE ASSESSMENT OF WORKER CHARACTERISTIC JOB REQUIREMENTS

The consistently high degree of relationship among ratings of worker characteristics, even where no logical or verifiable relationship exists, implies that job incumbents rated all items in approximately the same way. They did not discriminate effectively among worker characteristics that are relevant to performance of the OF tasks and those that are not relevant. Only the most basic evidence

of any discrimination appears in OF 70/71 ratings, where all physically oriented characteristics were rated in a somewhat different manner than the cognitively oriented characteristics. Even this distinction did not appear in the OF 33 ratings. In view of these findings it appears that OMU's decision to discontinue use of the inventory was a wise one.

The failure of job incumbents to make more meaningful ratings does not reflect deficiencies in their job knowledge, intelligence, or cooperation. Rather, the Marines were asked to perform a nearly impossible task: to make inferences from the possession of traits to actual job demands and job performance. The literature on selection is full of examples of other failures in this area. Even trained interviewers are typically able to predict future job performance little better than chance.[1] One reason is that there are many other determinants of performance which can and do interact with worker traits.

It is clear, however, that if estimates of required worker characteristics are to be made, a new approach will be necessary. The OMU staff should not rely on job incumbents, but only on job analysts who are trained in observation and interview methods for appraising these demands. This approach is the one used in almost all other reported studies where worker characteristics data were collected. On the other hand, job simulations, tests, or other more objective measures can generally be expected to provide more valid data. We found no other study in our review of the literature where job incumbents were asked to make inferences about their job performance by rating the worker characteristics required for effective performance. Possible reasons for the absence of this in the literature is discussed in Section IV of this report.

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[1] Webster, E. C., DECISION MAKING IN THE EMPLOYMENT INTERVIEW, Montreal: Industrial Relations Centre, McGill University, 1964; Mayfield, E. C., The Selection Interview -- A Re-Evaluation of Published Research, PERSONNEL PSYCHOLOGY, 1964, 17, 239-260. Also see: Wright, O. R. Summary of Research on the Selection Interview Since 1964, PERSONNEL PSYCHOLOGY 22 (3), 1969, pp. 391-413; Carlson, R. E. Improvements in the Selection Interview, PERSONNEL JOURNAL, 50 (4), 1971, pp. 268-275; Carlson, R. E., The Current Status of Judgemental Techniques in Industry in ALTERNATES TO PAPER AND PENCIL TESTING, Pittsburgh: Graduate School of Business, Univ. of Pittsburgh, 1973, pp. 1-68; and Stone, C. H. and Yoder, Dale, Selection, Interviewing and Testing, Chapter 4.4, pp. 4-117 to 4-158, in STAFFING POLICIES AND STRATEGIES, Vol. I, ASPA HANDBOOK OF PERSONNEL AND INDUSTRIAL RELATIONS, Wash., D.C.: The Bureau of National Affairs, Inc., 1974.

III

EFFECTIVENESS OF DIFFERENT APTITUDE TEST COMBINATIONS IN THE SELECTION OF MARINE CORPS AND NAVY ENLISTED PERSONNEL FOR SERVICE SCHOOLS

The Marine Corps relies heavily on aptitude test scores to select Marines for assignment to service schools and thus for the positions and careers to which they lead. The effectiveness of selection decisions depends, in part, upon the test combinations used, service school acceptance standards, and test validities. To evaluate current Marine Corps practice in this area, data were obtained from studies of Marine Corps and Navy aptitude tests conducted by the Naval Personnel Research and Development Center in San Diego (NPRDC).[2]

The data from NPRDC provide validity coefficients based upon intercorrelations among aptitude tests and service school training performance measured by final school grades. The Principal Investigator summarized analyses of the validity coefficents in the Final Report of Evaluation of the Marine Corps Task Analysis Program, Technical Report No. 16. However, it was not until after the Final Report was published that he discovered he had made an error in research reporting.

The Final Report states that the validity coefficients discussed in that report reflect relationships among the performance of Marines in Marine and Navy service schools and the aptitude tests used to select Marines for attendance at these schools. It was only as this present *Technical Report was being edited that the* Principal Investigator discovered that the NPRDC data are based upon Navy tests and the performance of Navy enlisted personnel in Navy service schools.[3] Although the Final Report misstates the population upon which the data are based, the statistical data summarized are accurate as they relate to the Navy.

Subsequent receipt from NPRDC of data based upon tests used by the Marine Corps to select Marines for attendance at Marine and Navy service schools support the conclusions in the Final Report that a different combination of tests than those now used provide better predictions of service school training performance in a number of instances. However, it should be noted that there are many more disparities among test batteries now used by the Navy and other test combinations that are more efficient,than were found in the study of Marine Corps tests. In spite of this, the recommendations in the Final Report apply equally to the Navy and the Marine Corps -- more research is needed on the effectiveness of selection instruments, and this research needs to be conducted periodically at more frequent intervals.

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[2]The cooperation and assistance of C. Leonard Swanson, Research Psychologist, NPRDC, San Diego, are gratefully acknowledged.

[3]The Final Report was prepared and published before the remaining five Technical Reports (including this one) were completed. This was done at the request of the Marine Corps Study Advisory Committee for our project.

The Principal Investigator accepts full responsibility for the error in research reporting in the Final Report. He also feels he owes a comment to the research sponsors about how the error occurred.

The NPRDC was involved in conducting research on aptitude tests for both the Navy and the Marine Corps at the same time. At the time our research staff members obtained data from NPRDC personnel, no written reports of either of the two studies were available. The data obtained were a large set of validity coefficients for a number of service schools. As a result of a misunderstanding, the staff members did not realize that the data they received were based only upon Navy personnel and not upon Marines. Based upon the staff reports given to him, the P.I. compounded the unknown misunderstanding by describing the Navy data as Marine data when he wrote the Final Report.

The study Directive for this research project specified that a draft copy of the final report be summitted to the Marine Corps Study Advisory Committee for its review before publication of the final draft of the report. This was done, and copies were distributed to each member of the Committee as well as to each member of our research staff. Comments from both groups were taken into account by the P.I. when he prepared the final version of the Final Report. However, no one questioned the analyses of the data presented from the NPRDC study even though a member of the Study Advisory Committee had received copies of the NPRDC studies of both Navy and Marine Corps aptitude tests several months earlier. After publication of the Final Report, and we had belatedly received the NPRDC study of Marine Corps tests, we found that the Marine Corps study covered 57 service schools and not the 79 discussed in the Final Report that are actually Navy service schools.

In view of the extensive analyses of the Navy data made by our staff, we have made the decision to report the results in this report. It is believed that the results can highlight the need for continuing research on selection standards by both the Navy and the Marine Corps. The report on evaluation of effectiveness of tests in Marine Corps service school selection standards follows the discussion of our analyses of the Navy test research.

A. THE VALIDITY OF NAVY TESTS USED AS PART OF THE SELECTION STANDARDS FOR ADMISSION TO NAVY SERVICE SCHOOLS

Table C-1 in Appendix C lists 37 of the 79 Navy service schools studied by NPRDC, the present combinations of tests upon which admission to each school is based, and correlations among scores on the test batteries and final school grades. Test batteries currently used for selection to these 37 schools have validity coefficients (correlations) as high or higher than other test combinations.

The table shows a wide range in the validity coefficients for test batteries in current use as aids in the selection of Navy enlisted

personnel for service school attendance. For example, the GCT and CLER test combination, used in selection for the Postal Clerk school, attained a validity of only .12. On the other hand, the ARI and 2ETST combination, used in selection for Tradesman-Training Devices Man (TD) and for Fire Control Tech-Phase 1 (FT) service schools, yielded a validity coefficient of .79.

At the time NPRDC conducted its research, four different test combinations were in use as important parts of the selection procedures for the service schools included in the study. The four test batteries are: GCT + ARI; ARI + 2ETST; GCT + MECH + SP; and GCT + CLER.[4]

Researchers at the NPRDC were interested first in determining the relationships among test scores and service school performance of Navy enlisted personnel and second, in discovering if selection could be improved by using other combinations of tests than those then in use. For each school, validity coefficients were calculated for each test individually and for all possible combinations of tests. These studies revealed some widespread disparities in reflecting relationships between test scores and FSG (Final School Grades) in Navy service schools.

For 42 of the 79 schools for which we have data, test combinations other than those currently used yielded superior validities. For each of these 42 schools, the alternate batteries which yielded improved prediction are listed, with the associated validity coefficients, in Table C-2 of Appendix C. Less than half of the 79 schools studied (37) used test combinations that yielded validities as high ($p \leq .05$) or higher than other possible test combinations (Table D-1, Appendix D).

In some cases, the improved validities for the 42 schools resulted from deleting one test from the presently used batteries. The MECH + SP combination, for example, provides a higher correlation ($r = .57$) with FSG at the Steelworker (SW) school than the presently used battery, GCT + MECH + SP ($r = .39$). For many of the schools, validity could be improved by replacing the present battery with a different, single test. The ARI test alone, for example, predicted FSG for both the Construction Electrician School (CE) ($r = .49$) and for the Signalman School (SM), San Diego ($r = .51$) much better than the presently used batteries. In fact, the presently used battery for Construction Electrician School, GCT + MECH + SP, has a validity coefficient of only .13, while the present

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[4]The abbreviated forms represent the following subtests of the Basic Test Battery (BTB) in the Navy Classification Test Battery that were used in the study: GCT = General Classification Test, ARI = Arithmetic Reasoning, MECH = Mechanical Comprehension, CLER = Coding Speed (Clerical Test), SP = Shop Practices, and ETST = Electronic Technicians Selection Test.

battery for the Signalman School, GCT + CLER, was only .12. (See Appendix C, Table C-2). These validities for presently used batteries are disturbingly low.

For most of the schools, improved validity could be attained by substituting a different battery. For the Submarine Electronic Equipment (ET) school, for example, where the ARI + 2ETST battery yielded a validity of .46, the substitution of a CLER + SP battery produced a validity coefficient of .67. The data presented in Table D-2, Appendix D, are arranged in descending order of the size of the improvement in validity coefficients obtained with new test combinations. These increases in validity range from .06 to .40, for the forty-two schools where potential increases were discovered in effectiveness of test batteries different from those in use at the time of the NPRDC study.

A further question that deserves investigation concerns the differences observed between the validities computed for service schools of the same type that differ theoretically only in location. For example, in Table C-2, it may be seen that the correlations between test scores and training performance (final school grades, FSG) in the Orlando, Florida, Yeoman school is quite different from that reported for the San Diego, California Yeoman school. Yeoman service school admission is based on the GCT + CLER test combination, which predicts FSG in Orlando relatively well ($r = .59$), but does not predict FSG as well in San Diego ($r = .19$). A new test battery, GCT + ARI, was shown to increase validity coefficients for both schools, from .59 to .70 in Orlando and from .19 to .33 in San Diego. However, there is still an important difference of .37 when results of improved predictive batteries for both schools are compared. This difference is very close to the difference of .40 in the original batteries.

In another example, the use of a new battery was successful in improving validity in one location but unsuccessful in another. The Electronics Tech A-1 schools at Great Lakes and at Treasure Island use a combination of the ARI + 2ETST tests as the test selection standard. This test combination yielded a validity of .70 for both schools. The NPRDC study found that using only the ETST test increased the validity coefficient to .82 for the Treasure Island school, but showed no improvement for the Great Lakes school. Without further data, we can only speculate about reasons for these differences. It is possible that differences in training methods or training emphasis at schools in different locations, differences in methods of evaluating training performance, deficiencies in the data, or chance factors may account for discrepancies of this nature.

Even greater differences in validity coefficients were found among schools of differing specialities. For example, a validity coefficient of .86 was obtained when final school grandes (FSG) in the Photographic Intelligenceman school were correlated with scores from a different battery, ARI + CLER + SP + ETST, than the one used

in selection for the school. On the other hand, even the most desirable test combination for Postal Clerk school, GCT + CLER, yielded a validity of only .12. A validity of this size usually indicates little predictive value, depending upon sample size, effects of false rejections, effects of false admissions, and other factors.

B. THE VALIDITY OF APTITUDE TESTS USED BY THE MARINE CORPS IN THE SELECTION OF MARINES FOR TECHNICAL SERVICE SCHOOL TRAINING

The NPRDC study of Marine Corps aptitude tests is based upon statistical comparisons of final school grades of Marine Corps students in 57 Class "A" service schools and aptitudes of these Marines as measured by tests in the Army Classification Battery (ACB-61).[5]

The ACB-61 has been used for many years to determine eligibility of enlisted Marines for assignment to school or on-the-job training. Purpose of the study was to evaluate the ACB-61 as a predictor of final course grades of Marines in class "A" schools.

The Army Classification Battery (ACB-61) is composed of eleven subtests. Seven weighted pairs of these subtests have been used as "composites" in test batteries for most of the service school courses studied. However, for some courses, four tests are used separately as selectors. These are the AR and PA from the ACB-61, and two tests that are not a part of the ACB -- the ETST and EDPT. The ACB subtests and composites, and the two non-ACB predictor tests, are listed below with their titles and abbreviations.

ACB SUBTESTS

ACS - Army Clerical Speed

AI - Automotive Information

AR - Arithmetic Reasoning

ARC - Army Radio Code

CI - Classification Inventory

ELI - Electronics Information

GIT - General Information Test

MA - Mechanical Aptitude

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[5]Navy Personnel Research and Development Center, VALIDATION OF THE ARMY CLASSIFICATION BATTERY (ACB-61) FOR THE MARINE CORPS STUDENTS IN 57 CLASS "A" SCHOOLS, San Diego: NPRDC, October, 1975.

PA - Pattern Analysis

VE - Verbal

SM - Shop Mechanics

ACB COMPOSITES -- Weighted Pairs of Subtests

AE - The Armor, Artillery, Combat Engineers = $\frac{GIT + AI}{2}$

CL - Clerical = $\frac{VE + ACS}{2}$

EL - Electronics = $\frac{MA + 2ELI}{3}$

GM - General Mechanics = $\frac{PA + 2SM}{3}$

GT - General Technical = $\frac{VE + AR}{2}$

IN - Infantry Combat = $\frac{AR + 2CI}{3}$

MM - Motor Mechanics = $\frac{SM + AI}{2}$

NON-ACB Predictor Tests

EDPT - Electronic Data Processing Test

ETST - Electronics Technician Selection Test (From Navy)

Data for each of the 57 service school courses were analyzed separately for each school. Correlations among final school grades and each subtest were computed, and a stepwise multiple regression analysis was performed for each sample. The latter initially selects the most valid predictor, followed by the second predictor that adds the greatest validity when added to the first. The procedure continues until a point at which less than some pre-determined increase over the validity in the preceding step is reached. A $P \leq .01$ was used in the NPRDC study.

Valitities of the subtests were corrected for restriction in range using a technique developed by Lawley.[6] Validities of the selector composites used for assignment to each school or course were corrected

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[6]Lawley, D. N., A Note on Karl Pearson's Selection Formulas, PROC. ROYAL SOC. EDINBURGH, SEC. A., 1943, 62 Part I, 28-30.

by the formula described by Thorndike.[7]

The two or three most valid ACB subtests for each course were identified and compared with currently used selector composites and subtests. These data are presented in Table D-1 in Appendix D. The maximum multiple correlations for all ACB subtests for each course were also computed, and appear in the last column of the table.

Examination of the table reveals that the two most valid subtests are included in the current selector composites for 22 (39%) of the 57 courses. At least one of the two most valid subtests is used as a selector in an additional 21 courses (37%). Column 6 in the table lists the most valid subtests, with underlining of those currently used. In the remaining 14 courses (25%), neither of the two most valid subtests is currently used as a selector.

The validity data were examined further to determine where changes in selector tests would appear to yield worthwhile increases in validities. Twelve courses with at least moderate sample sizes were thus identified: 0106, 0201, 1001, 2020, 2220, 5328, 5420, 6005, 6010, 6450, 7300, and 8001. Changes in selectors for each of these courses were proposed. Uncorrected validities for the revised selectors and selector composites were computed and compared with uncorrected validities of currently used selectors. The differences were statistically significant ($p < .01$) for seven courses. These data are presented in Table D-2 in Appendix D for the seven courses where significant improvements in validity were found. Course 0105, Sea School Indoctrination, is included as an eighth course because it is the same as course 0106 but in another location. With course content the same, it was considered that it should have the same selector regardless of location. It is interesting that an improvement in selector validity was possible for the course as it is handled in Portsmouth but not in San Diego.

The validation studies conducted at San Diego suggest that the aptitude tests used by the Marine Corps in selection for service school training are generally effective for a majority of the schools. Scores on the ACB-61 selector composites predicted final course grades reasonably well for 43 of the 57 courses included in this analysis. However, this conclusion cannot be fully accepted without some reservations. Validities may be questioned for the 24 courses in which sample sizes are below 100. Coincidentally, there are 24 courses in which one or more ACB subtests not used as a selector has a higher uncorrected validity than the most valid subtest that is used as a selector. Eleven of these courses have sample sizes of 100 or more--one with an N of 102 and one with 109. The remainder

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[7]Thorndike, Robert L., PERSONNEL SELECTION. New York: John Wiley and Sons, 1949, p. 173.

range from an N of 162 to 673. These reservations are not cited as a criticism of the NPRDC research. They are intended to suggest caution in the interpretation of the data, and to emphasize the importance of broader support by the Commandant of the Marine Corps for the more comprehensive and continuing research needed to ensure the development of maximally effective selection procedures in the Marine Corps.

The most valid selector composites and their average uncorrected validities are these: MM(.45), AE(.42), GT(.39), CL(.39). The least valid composite was EL with an average uncorrected validity of .22. Four tests are used separately as selectors. These four and their average uncorrected validities are AR(.38), EDPT(.36), ETST(.33), and PA(.13). While the first three may be ragarded as fairly satisfactory selectors, the PA subtest is considered inadequate for predicting grades in the three courses where it is presently used. This does not mean, however, that the PA subtest has no value for selection in other schools. Finally, it appears that the validity of the selection process can be improved significantly for at least 7 of the 57 schools merely by adding or deleting certain tests, as indicated below.

It is recommended that the test composites used in selection for the following courses listed below be revised as follows:

Course Code	Course Name	Recommended Selector
0105	Sea School Indoctrination, San Diego, CA	GT + IN + GIT
0106	Sea School Indoctrination, Portmouth, VA	GT + IN + GIT
0201	Tank Crewman	AE + SM
1001	Aviation Basic E & E	GT + ELI + PA
2020	Field Radio Operator	EL + GT + PA
2220	Air Controlman	GT
5420	Personnel Financial Records	AR + ACS
7300	Engineering Equipment Operator	MM + VE + CI

As shown in Table D-1, there are several courses for which none of the ACB aptitude tests appear to be very effective predictors of course grades. For course 6460, Aviation Ordinanceman, for example, validities of currently used tests are only .12 and .17. Substitution of other tests did not greatly improve prediction. Again, further research is needed to develop more effective selection procedures.

As indicated earlier, there are wide variations in sample sizes for courses studied by NPRDC. As shown in Table D-1, the available samples ranged in size from 34 to 1852. These variations affect the

likelihood of detecting a significant effect. It is recommended that the data for courses with small samples be reanalyzed when additional data become available.

It is also recommended that more attention be given to validating other aspects of the selection and training process. All of the data in this study are based upon final course grades, but do course grades effectively predict performance in the field? What is the validity of selection procedures used in addition to the ACB tests that also influence selection decisions? What are the differences in the way courses are taught and training performance graded in different locations? A more comprehensive approach to the validation of all selection procedures for service school training and evaluations of training methods is needed.

The findings of significant disparities among service school selection batteries and service school training performance of both Navy and Marine enlisted personnel led us to investigate the basis for establishment of service school selection standards. Inasmuch as our analysis of Navy selection methods may be termed as "accidental", and the primary focus of our research is the Marine Corps, our investigation of previous selection studies was limited to Marine Corps research.

We found that the most recent research on Marine Corps selection test batteries, prior to inception of our research project, was conducted in 1963. We have been unable to find any studies between that date and those conducted at NPRDC, San Diego within the last year and a half.

The 1963 studies were commissioned by the Marine Corps and conducted by H. A. Edgerton. Edgerton's studies were based upon a classification test battery made up of eleven tests obtained from the Army (the ACB-61). It was hypothesized that the similarity between many Marine Corps and Army jobs permitted direct utilization of the Army tests for Marine Corps purposes. However, it was found that some differences between Army and Marine Corps jobs did exist, and effectiveness of the tests was therefore evaluated exclusively in terms of Marine Corps experience.

In Edgerton's research, the records of Marines attending several service schools, and Marines in selected non-schooled MOS's, were reviewed and analyzed. A similar analysis was conducted for Marine Aviation MOS's. This research resulted in identification of several aptitude-areas based upon test combinations that yielded the highest correlations between an aptitude area and a given group of Marine Corps jobs. These standards have remained in effect continuously since 1963. We have been unable to find any evidence of cross-validation studies or revalidation studies since that time until the recent validity studies conducted by NPRDC, San Diego for both Marine

Corps and Navy tests. Although it is not known when the original Navy research to set selection standards was conducted, it appears that the results of Edgerton's research have stood the test of time more effectively than the original Navy studies.

We were recently informed that the Marine Corps Operations Analysis Group (MCOAG) conducted some preliminary studies during 1975 of the relationships among a number of variables and the service school performance of enlisted Marines. We requested data from these studies but were advised that due to the preliminary nature of the research, no results would be released until further studies had been completed. We are therefore unable to comment about any relationships between findings of these studies and those conducted by NPRDC, San Diego during the same time span. However, the extent of the research undertaken by both MCOAG and NPRDC within the last year and a half suggests that there may be a growing recognition within the HQMC of the importance of personnel research to maintenance of the effectiveness of the Marine Corps in accomplishment of its mission. The results of the NPRDC studies of Navy tests may have the same impact upon Navy research efforts.

As noted earlier, between 7 and 24 of the test batteries (12% to 42%) now in use as one of the criteria for selection of Marines for 57 Marine Corps service schools, have less effective validities than other test combinations. It is our recommendation that results of the research conducted at the NPRDC, San Diego be used as the basis for establishing new test batteries for service school selection in those cases where different test combinations have been demonstrated to have higher validities than those now in use.

We have been told that the Armed Services Vocational Aptitude Battery (ASVAB) will soon be the standard selection and placement battery for all armed services including the Marines. Budgets should be planned now for validating the ASVAB in relation to service school training performance. And, even more importantly, job performance standards for each MOS need to be developed and then correlated with ASVAB test scores in order to ensure placement of recruits in the most suitable MOS's in relation to their aptitudes.

It is recommended that the Marine Corps conduct periodic validi studies of the aptitude tests in every area in which they are used as part of a decision-making process. Selection standards must be continuously reviewed, using rigorous research methodologies, if they are to continue to be effective. As conditions change, standards must be changed. Changes in conditions, whether these are changes in instructional methods, changes in methods of evaluating performance, or changes in technology, as well as changes in the nature of new Marine Corps recruits, can all affect validities of tests and test batteries obtained under different conditions and with different populations. The Marine Corps needs to develop means to identify and

measure the effects of these changes and to take action accordingly.

Our studies suggest that the Marine Corps has not provided full support to personnel research activities. This appears to have been especially true for the years between 1963 and 1975. Sound research is needed to develop selection and placement procedures that will effectively improve the identification of civilians who will be the best recruits, and the Marine recruits who are best suited for training in OF's requiring special aptitudes. We recommend substantially stronger support from HQMC for the personnel research function. This is considered essential to ensure that the Marine Corps' traditional standards of excellence are maintained, and that fulfillment of its mission will continue through improved methods of identifying for recruitment and for specialized training, the men and women who possess the qualities needed to meet the high standards of Marine Corps service.

IV

ALTERNATIVE APPROACHES TO THE ASSESSMENT OF WORKER CHARACTERISTICS

Section II of this report reviews the use of the OMU Worker Characteristics Inventory in Marine Corps Task Analysis. Studies of Marine Corps data, conducted as part of that review, indicate that data gathered by the previously used OMU Inventory provide information that is neither reliable nor valid, and is therefore not useful. It should be clear that if those worker characteristics that are not readily measured by objective tests are to be of any significant benefit in improving classification and assignment in the Marine Corps, some new and different procedure for generating dependable data is needed.

Several of the best-known methods for measuring worker characteristics deserve note. This section summarizes a number of these. This is followed by an overview of relationships among worker characteristics and performance, purposes and methods of assessment, the use of a systems approach in classification and assignment, and the importance of job performance measures. The section closes with a summary of considerations in choosing alternative methods of assessing worker characteristics.

A. MAJOR METHODS FOR MEASURING WORKER CHARACTERISTICS

Developments in techniques for measuring characteristics required of workers have usually been an integral part of the research and development of complete job analysis methodologies. The method developed by the U.S. Department of Labor is the most extensive and widely used job analysis procedure in the United States.

THE DEPARTMENT OF LABOR METHOD

The department of Labor's U.S. Training and Employment Service (USTES) defines job analysis as the process of determining what the worker does in relation to Data, People, and Things. This method includes describing the traits required of the worker for satisfactory performance, as well as description of machines, tools, equipment, and work-aids used, the materials, products, subject matter, and services involved, and the skills and techniques employed on the job. A complete description of the evolution of this procedure and its rationale appears in a 1970 Labor Department document, "Job Analysis in the United States Training and Employment Service."[8] The most current and comprehensive description of the components

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[8]U.S. Department of Labor, Manpower Administration, JOB ANALYSIS IN THE UNITED STATES TRAINING AND EMPLOYMENT SERVICE, Washington, D.C.: U.S. Government Printing Office, 1970.

of the method are contained in Handbook for Analyzing Jobs, published by the Department in 1972.[9]

For many years after the Employment Service was established in 1933, the DOL method placed little emphasis on the characteristics required of the worker. This reflected conditions in the labor market, which was comprised of a surplus of workers and a shortage of jobs, until World War II. The standard form used for recording job data, the Job Analysis Schedule, contained only three items: experience, training, and performance requirements. The item, "performance requirements" was divided into four catetories: responsibilities, job knowledge, mental application, and dexterity and accuracy.

World War II changed the job market drastically. Highly selective hiring on the basis of experience was replaced by an urgent need to recruit for defense jobs. The acceptance of inexperienced workers with potential for job performance became common practice. This led to a need for a more sophisticated system of analyzing jobs in terms of trait requirements. The USES (now USTES) responded to this need by adding two attachments to the Job Analysis Schedule: 1. a form for recording Physical Demands of the job; 2. a Worker Characteristics Form for recording the "personal traits" required of the worker. Examples of some of the "personal traits" include the following: ability to relate abstract ideas, ability to plan, memory for detail, persuasiveness, liking for people, facility with language, dexterity, and muscular control.

In 1949, the Department of Labor initiated a project to develop a new classification system that would reflect all the significant aspects of a job, especially those in two basic categories: what the worker does and what requirements are made on him. This project, known as the Functional Occupational Classification Project, included an effort to define, categorize and standardize worker characterisitics, and to establish techniques and an instruction manual for determining Worker Traits. Much of the data from this development activity was published in 1956 in Estimates of Worker Traits Requirements for 4,000 Jobs as Defined in the Dictionary of Occupational Titles.[10]

This data base has been used over the years in developing and refining the basic job analysis method. New data are also collected and used experimentally in the Occupational Analysis Field Centers and Occupational Analysis Special Projects located in various parts of the nation. At present, a complete USTES job analysis involves having job analysts collect information in five categories: 1. Worker Functions, 2. Work Fields, 3. Machines, Tools, Equipment, and Work Aids, 4. Materials, Products, Subject Matter, and Services, and, 5. Worker Traits.

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[9]U.S. Department of Labor, Manpower Administration, HANDBOOK FOR ANALYZING JOBS, Washington, D.C., U.S. Government Printing Office, 1972.

[10]U.S. Department of Labor, Bureau of Employment Security, ESTIMATES OF WORKER TRAITS REQUIREMENTS FOR 4,000 JOBS AS DEFINED IN THE DICTIONARY OF OCCUPATIONAL TITLES, Washington, D.C.: U.S. Government Printing Office, 1956.

Worker Traits Measurement in the Department of Labor. The requirements made on a worker are categorized into five Worker Trait Components: Training Time, Aptitudes, Temperament, Interests, and Physical Demands. Briefly, these are defined as follows:

Training Time refers to level and amount of general and specialized education required for average satisfactory performance of a job. It is composed of two parts:

1 - General Educational Development. This includes all formal and informal education which contributes to (a) the worker's reasoning ability and ability to follow instructions, and (b) the acquisition of "tool" knowledge, e.g. a foreign language or mathematical skills,

2 - Specific Vocational Preparation. This refers to the amount of time spent in specific vocational training.

Aptitude refers to the capacities for learning some task or discipline. The eleven aptitudes identified by the Department of Labor are: 1. Intelligence, 2. Verbal, 3. Numerical, 4. Spatial, 5. Form Perception, 6. Clerical Perception, 7. Motor Coordination, 8. Finger Dexterity, 9. Manual Dexterity, 10. Eye-Hand-Foot Coordination, and 11. Color Discrimination.

Temperament refers to "personality qualities which remain fairly constant and reveal a person's intrinsic nature." Because the measurement of temperament has proved to be complicated, these trait requirements are determined indirectly by identifying job situations that would be expected to require certain temperaments. The analyst judges the extent to which the worker would have to adjust to one or more of these situations:

1. Variety of duties often characterized by frequent change.

2. Repetitive or short cycle operations carried out according to set procedures or sequences.

3. Direction, control, and planning of an entire activity or activity of others.

4. Dealing with people in actual job duties beyond giving and receiving instructions.

5. Situations involving influencing people in their opinions, attitudes, or judgements about ideas or things.

6. Performing adequately under stress when confronted with the critical or unexpected, or taking risks.

7. Evaluation of information, generalizations, values or decisions against sensory and/or judgmental criteria.

8. Evaluation of information, generalizations, standards or decisions against measureable and/or verifiable criteria.

9. Interpretation of feelings, ideas, or facts in terms of personal viewpoint.

10. Precise attainment of set limits, tolerances, or standards.

Interest refers to personal preferences for a category of activities. Five categories are used:

1. Dealing with things and objects versus people and the communication of ideas.

2. Business contacts with people versus those of a scientific and technical nature.

3. Routine, concrete, organized nature versus an abstract and creative nature.

4. Working for people for their presumed good as in the social welfare sense or for dealing with people and language in social situations versus activities which are nonsocial in nature, and activities that are carried on in relation to processes, machines and techniques.

5. Prestige or esteem of others versus tangible, productive satisfaction.

Physical Demands refers to the physical and environmental requirements made on the person by the job. These should not be confused with the physical traits or capacities possessed by the worker. Thirteen factors are assessed, in the physical and environmental categories:

Physical Activities Factors

1. Strength

   a. Lifting, Carrying, Pushing, Pulling.

   b. Sedentary, Light, Medium, Heavy, Very Heavy.

2. Climbing, Balancing.

3. Stooping, Kneeling, Crouching, Crawling.

4. Reaching, Handling, Fingering, and/or Feeling.

5. Talking and/or Hearing.

6. Seeing.

Environmental Conditions Factors

1. Work Location.
2. Extreme Cold With or Without Temperature Changes.
3. Extreme Heat With or Without Temperature Changes.
4. Wet and/or Humid.
5. Noise and/or Vibration.
6. Hazards.
7. Atmospheric Conditions.

THE POSITION ANALYSIS QUESTIONAIRE

Another widely known approach to job analysis that contains measures of worker characteristics is the Position Analysis Questionnaire (PAQ), developed by Ernest J. McCormick and his associates at Purdue University's Occupational Research Center.

The PAQ consists of 189 "job elements", which are "generalized human behaviors involved in work."[11] McCormick distinguishes between job-oriented and worker-oriented job elements. Job-oriented elements refer to the technological aspects of the job and what is achieved by the worker while worker-oriented elements describe the generalized human behaviors involved in the job. (See Appendix E for list of job elements.)

The main interest here, however, is in another aspect of the PAQ, a list of 76 human traits which may be required in a given work setting. The list contains several items obviously adapted from the Department of Labor Worker Traits, specifically, Aptitudes, Temperaments, and Interests. Others are similar to Guilford's Structure of Intellect.[12] The list includes both aptitudes and situational demands.

FUNCTIONAL JOB ANALYSIS

Functional Job Analysis is designed to combine job analysis and

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[11]McCormick, Ernest J., Jeanneret, Paul R., and Mecham, Robert C., THE DEVELOPMENT AND BACKGROUND OF THE POSITION ANALYSIS QUESTIONNAIRE (PAQ), West Lafayette, Ind.: Occupational Research Center, Purdue University, 1969. Also see: McCormick, Ernest J., Mecham, Robert C., and Jeanneret, Paul R., TECHNICAL MANUAL FOR THE POSITION ANALYSIS QUESTIONNAIRE (PAQ), West Lafayette, Ind.: PAQ Services, 1972.

[12]Guilford, J. P., THE NATURE OF HUMAN INTELLIGENCE, New York: McGraw-Hill Book Co., 1971.

systems analysis. The technique was developed by Sidney A. Fine of the W.E. Upjohn Institute for Employment Research.[13] The method was derived from the Department of Labor methodology, and retains certain scales, e.g. the Worker Functions scale and the General Educational Development scales, but there are significant changes in the approach and the addition of several new scales.

Rather than simply observe and report what people do, the analyst must, in the beginning, determine the goal or purpose of the agency in which the jobs occur. The next step is to determine what must be done to achieve the goal or goals. Subgoals and subtasks are then determined. The analyst determines the tasks which should or would serve the organization's objectives, whether they are being performed or not. The actual way work is currently being performed is also analyzed.

Among the additional scales used in FJA is the Scale of Worker Instructions. This indicates the degree of discretion and choice of work methods the worker faces in accomplishing the task. The eight point scale ranges from situations where "inputs, outputs, tools, equipment, and procedures are all specified" to situations where "information and/or direction comes to the worker in terms of needs (tactical, organizational, strategic, financial)."

Another feature of FJA is the use of the Worker Functions scales to determine not only the degree of complexity but the degree of orientation to data, people, and things. A percentage is assigned to each of these three types of orientation, to indicate the relative involvement required in each area by the job. Each area must be reported as required at least 5% of the time.

HEALTH SERVICES MOBILITY STUDY

Since 1967, Eleanor Gilpatrick has headed the development of the Health Services Mobility Study. The method for analyzing tasks is only part of an entire system, which is designed to facilitate upward mobility and career development for health professionals.[14] The basic task data, collected by trained analysts, are transformed into curriculum objectives, performance standards, and job ladders designed to allow a person to be promoted systematically, building on learned skills, related tasks, knowledge and experience. This system, if adopted in its entirety, would require staff skills, training and resources beyond the reach of most organizations. It should be most appropriate for organizations who share the problems of the health care industry, including these: 1. credentialing requirements which may not be related

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[13] See: Fine, Sidney A., and Wiley, Wretha W., AN INTRODUCTION TO FUNCTIONAL JOB ANALYSIS: A SCALING OF SELECTED TASKS FROM THE SOCIAL WELFARE FIELD, Kalamazoo, Mich.: The W. E. Upjohn Institute for Employment Research, 1971.

[14] A summary of the system and the methods employed is given in: Gullion, Christina, and Gilpatrick, Eleanor, THE DESIGN OF CURRICULAR GUIDELINES FOR EDUCATIONAL LADDERS USING TASK DATA, Working Paper No. 11, Health Services Mobility Study, Contract No. 82-34-69-34, Manpower Administration, U.S. Dept. of Labor.

to job performance, with inadequate consideration being given to experience and training in lower level or related positions; 2. artificial barriers to the promotion and utilization of women or other sterotyped groups, with the result that they are concentrated in certain occupational areas, e.g. nursing, food service; 3. a shortage of appropriate training and educational opportunities, which limits personal growth and progression through career ladders.

The measurement of worker characteristics in the HSMS system is integrated with the task analysis methodology. Jobs are rated by trained analysts on 16 scales, representing learnable skills. These skills are organized into six categories: manual, interpersonal, language, decision-making, general intellectual, and responsibility. Each task is rated in terms of the proficiency level required in each skill area, and on an additional dimension of task frequency.

A subsystem of the HSMS method is the Knowledge Classification System and Knowledge Scale. The analyst uses these instruments to report first the particular subject areas where knowledge is required, and secondly the level of knowledge required. Knowledge level requirements are recorded using two criteria, breadth of knowledge and depth of understanding.

B. SPECIALIZED DEVELOPMENTS IN THE USE OF WORKER CHARACTERISTICS DATA

In addition to the major methods for assessment of worker characteristic requirements, there have been several research and development efforts in the general area of task analysis, that were adapted to specific occupational fields or focused on special problems and objectives. Some of these include innovative approaches to the assessment of worker demands.

THE JOB INFORMATION MATRIX SYSTEM (JIMS)

Research conducted by C. Harold Stone and Dale Yoder at the California State Universities at Long Beach and Los Angeles revealed several weak areas in traditional job analysis methodology.[15] These included

1. Subjectivity of data--different choices of words, different meanings and interpretations by various analysts over time.

2. Inadequate reliability and validity of data.

3. Inadequate methods of quantifying for statistical analysis and computer storage and retrieval.

4. Outdated job data.

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[15]Stone, C. Harold, and Yoder, Dale, JOB ANALYSIS 1970, Long Beach, Calif.: California State University, Long Beach.

5. Inadequate methods of cross-indexing data for selective retrieval.

6. Dependence upon scarce, trained analysts. A simplified, standardized procedure that could be used by personnel with only moderate training could reduce the cost of analysis.

7. Traditional job analysis methodology is time consuming, which adds to costs.

In an effort to overcome or reduce these problems, a method was devised for obtaining current, valid job data in less time and at less cost than the traditional observation-interview technique. The product of this research is the Job Information Matrix System (JIMS). The system begins with the preparation of standardized checklists which contain items describing the tasks in a given occupational family. A vocabulary of action verbs was developed and standardized so that task description statements can be interpreted without ambiguity, even by analysts with only minimal training. Jobs within a family are then analyzed using the common checklist, either by analysts, task supervisors, or even task performers. The matrix modular format and standardized vocabulary of the checklist facilitate computer storage, retrieval, and cross-indexing of data for comparing jobs. The advantages of the system, include reduced dependence on trained analysts, greater consistency in ratings due to the standardized vocabulary, and an improved capability for comparing common tasks and requirements across jobs. This last feature is the point of interest here; standardization in task descriptions is emphasized as a way to improve the matching of people to jobs, classification and assignment, and job evaluation.

Perhaps the most difficult aspect of the method is that checklists for each occupation or job family have to be developed; the method assumes that certain tasks are common to many of the jobs in a given job family.

JOB TASK AND REQUIREMENTS ANALYSIS (JTRA)

The Humanic Designs Corporation (HDC) uses the term, Job Task Requirements Analysis, to refer to its approach to task analysis.[16] HDC's developmental activities have not resulted in creating new methodologies but in evaluations of existing approaches and determining which procedures are most effective for specific situations and specific objectives. Among the findings relevant to our study is the conclusion that certain of the Labor Department's Worker Traits measurements, specifically Interests, Temperaments, and Physical Demands, are "not, on the whole, relevant to the design of an upward mobility system."

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[16]Humanic Designs Corporation, INCREASING EMPLOYEE MOBILITY OPPORTUNITIES: AND EMPLOYER'S HANDBOOK FOR SYSTEM DESIGN, New York: Humanic Designs Corporation, 1972. (Contract No. 82-34-70-04, U.S. Department of Labor.

The data obtained from these scales is useful for initial selection of workers, placement, and in job restructuring. For career development purposes, the Health Services Mobility Study appears to be more useful because of its emphasis on identifying unidimensional skill and knowledge requirements.

Findings by HDC emphasize the value of allowing the objective of task analysis to determine the choice of methods. In the area of classification and assignment, the objective of mere "upgrading" is differentiated from the design of an upward mobility system. Upgrading is defined as "facilitating the movement of employees one step upward rather than into broad channels of career progression." An upward mobility system, however, "deals with movement of people through all or major segments of the jobs and positions within an organization." Upgrading requires only the identification of the skills and knowledge needed for task performance; if good task descriptions are available, they can be used to supply this information. On the other hand, an upward mobility system requires precise scaling of the identified skills and knowledge, in order to place the task appropriately in a multi-level job ladder, and in order accurately to specify levels of training and educational requirements.

THE CHICAGO POLICE DEPARTMENT STUDY

A different approach to the determination of job qualifications is illustrated in the 16 month study of patrolmen's jobs by the Chicago Police Department.[17] Rather than gather comprehensive job content information or determine knowledge and skill requirements, they sought to identify the behavioral requirements of the field patrolman's job. The analysis began with a general orientation to the Police Department organization, its facilities and procedures. This was followed by a thorough schedule of observation; the staff rode with the patrolmen at all hours of the day, through a cross section of Chicago's neighborhoods. The result was a list of twenty behavioral requirements. This information was used as a basis for selecting psychological tests, test standards, and procedures to be used for selecting entry-level patrolmen. The tests were compiled from existing sources. The test battery was validated by comparing the test battery scores with several objective and subjective criterion measures. These included semi-annual performance ratings, a paired-comparison appraisal technique developed at the University of Chicago Industrial Relations Center, and personnel file data such as departmental awards, citizen complaints, disciplinary actions, and number of arrests made.

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[17]Baehr, Melany E., Furcon, John E., and Froemel, Ernest C., PSYCHOLOGICAL ASSESSMENT OF PATROLMAN QUALIFICATIONS IN RELATION TO FIELD PERFORMANCE, Chicago: Industrial Relations Center, University of Chicago, 1968. (Grant No. 046, Office of Law Enforcement Assistance, U.S. Department of Justice.)

One reason the researchers chose to study behavioral requirements of the job is that the skill requirements and demands faced by field patrol officers in Chicago, although not unique to that job, are sometimes very different from those of industrial workers, commercial, administrative, or service personnel, and other types of workers for whom the traditional measures of worker characteristics were developed. Some of the behavioral requirements they found, listed below, are not unlike those which may be expected of Marines under combat conditions:

- Make prompt and effective decisions, sometimes in life and death situations, and be able to size up a situation quickly and take appropriate action.

- Maintain a balanced perspective in the face of constant exposure to the worst side of human nature.

- Tolerate stress in a multitude of forms, such as meeting the violent behavior of a mob, arousing people in a burning building, coping with the pressures of a high-speed chase or a weapon being fired at the officer, or dealing with a woman bearing a child.

- Exhibit a number of complex psychomotor skills, such as driving a vehicle in normal and emergency situations, firing a weapon accurately under extremely varied conditions, maintaining agility, endurance, and strength, and showing facility in self-defense and apprehension, as in taking a person into custody with a minimum of force.

- Have the facility to act effectively in extremely divergent interpersonal situations. An officer has contact with paracriminals, informers, and people on the border of criminal behavior besides the dealings with criminals. At the same time, officers must relate to the people on their beat--businessmen, residents, school officials, visitors, etc. Their interpersonal relations must range up and down a continuum defined by friendliness and persuasion on one end and by firmness and force at the other.

Most of these behavioral abilities require skills that are difficult to measure. Research suggests that psychological tests do not predict these skills very well. A follow-up study examined the relationships among scores on the test battery and successful job performance of patrolmen. The results were disappointing.[18] The Chicago Police Dept. study illustrates some of the special problems of determining qualifications for jobs where the worker characteristics required include psychological and emotional stability in high stress situations.

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[18] Kent, Deborah Ann, and Eisenberg, Terry, The Selection and Promotion of Police Officers, THE POLICE CHIEF, Vol. 39, No. 2, February, 1972, pp. 20-29.

PRIMOFF'S JOB ELEMENT PROCEDURE

Upward Mobility Through Job Restructuring: The Primoff Technique

The U.S. Civil Service Commission has used a technique for several years that was developed by Ernest Primoff of the Commission.[19] It is designed to assess worker qualifications for Federal blue collar jobs. The method utilizes an important principle in job analysis, i.e. that when jobs are described abstractly in terms of their elements, common elements across various occupational areas can be identified. The advantage of this approach is that transfer and placement opportunities are created, career ladders clarified, and upward mobility is facilitated. The disadvantage, in addition to the expense of the method, is the difficulty of attaining and maintaining precision in dynamic or developing work situations.

A job element in the context of Primoff's technique is quite different from the task element concept in the U.S. Department of Labor methodology. Job elements refer to the skills, knowledges, and abilities (SKA's) required for successful job performance. Rather than relying heavily on a record of the years expended in education or in specific work situations, as so many methods do, the examiner utilizes whatever is the most appropriate examining procedure to determine if the job applicant actually possesses the required job elements; he is not concerned with how the job elements were acquired. For a typing job for example, only a work sample of typing would be required, rather than a certification of special training or a record of experience. Some examples of job elements are given below. These elements describe Budget Technician jobs, GS levels 5-8.

a. Work from complex rules, regulations and procedures with minimum assistance from supervisor.

b. Perform accurately work which requires meticulous attention to detail.

c. Communicate information or ideas (oral or written) by means of letters, memos, summaries, reports, etc.

d. Work with and abstract quantitative data from a variety of standard forms and other data sources.

e. Recognize problem areas and inconsistencies in data.

The process of determining job elements required by a specific job

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[19]Primoff, Ernest S., THE JOB ELEMENT PROCEDURE IN RELATION TO EMPLOYMENT PROCEDURES FOR THE DISADVANTAGED, Washington, D.C.: U.S. Civil Service Commission, 1972. Also see, Primoff, Ernest S., SUMMARY OF JOB-ELEMENT PRINCIPLES, PREPARING A JOB ELEMENT STANDARD, (Draft), Personnel Measurement and Development Center, U.S. Civil Service Commission, August, 1971.

differs from traditional job analysis both in terms of the method of collecting the information and the product of the process. In the Primoff technique, the job elements (SKA's) are determined through group discussions which involve supervisors, workers and other experts. Task statements may be used, however, in the definitions of task elements, to illustrate work situations where the job element is demonstrated. Task statements may also be used in scaling the job element. That is, the levels of difficulty for a given job element may be most easily and meaningfully identified using task statements, ordered in terms of difficulty. An example is given below for the first job element mentioned earlier, "work from complex rules, regulations, and procedure with minimum assistance from supervisor."

- Applying official and/or legal business terminology and documentary regulation.

- Dispensing information relative to the correct interpretation of rules and regulations governing such matters as insurance, education, employment, and housing.

- Allocating and insuring the proper utilization of personnel, equipment, supplies, services, or facilities for specific purposes according to predetermined schedules, priorities, and procedures.

- Interviewing applicants for employment and processing application forms according to established procedures.

- Scanning documents and deriving pertinent points.

By identifying job elements, the qualities being sought in the applicant are clarified. It is claimed that this improved the selection of the most appropriate instruments for selection and placement. The whole spectrum of examining tools, from job simulations to a review of work history, is available to the personnel specialist; this reduces the dependence on aptitude tests and generalized credentials such as diplomas. However, various types of written tests are used if found to be the most appropriate selection tools.

C. STUDIES OF RELATIONSHIPS AMONG WORKER CHARACTERISTICS AND PERFORMANCE CRITERIA

In addition to the major projects mentioned above, the literature of task analysis includes many studies reporting relationships of varying degrees among measures of worker characteristics and specific performance criteria, e.g. re-enlistment rate, proneness to neurosis. In the efforts to identify predictors of various performance variables of interest to the military, researchers have used a large variety of worker characteristic measures as independent variables, including age, rank, attitude of wife or girl friend toward the service, and

satisfaction with service life;[20] officers' abilities, interests, and attitudes;[21] role stress, satisfaction, and leader behavior;[22] values of officers;[23] need for achievement;[24] perceived utilization of talents and training;[25] and many aptitude, achievement, and vocational tests.[26] One study even found soldiers' birth order significantly related to four criterion variables. First-born sons were more successful in the service, over-represented among leaders, more prone to neurosis, and committed fewer violent crimes.[27]

The variety of criterion variables illustrates the high degree of specificity in dependent variables so often found in journal articles. Even where dependent variables appear to be of a general nature, e.g. promotions, there are usually a number of context variables, possible interactions among variables, method variables and many other aspects of the situation, which, when taken together, limit

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[20]O'Gorman, J. G., THE PREDICTION OF REENGAGEMENT AMONG RANKS OF THE AUSTRALIAN REGULAR ARMY IN THEIR FIRST TERM OF SERVICE. Australian Military Services Research Report, 1972, No. 3/72.

[21]Helme, W. H., L. P. Willemin, and Day, R. W., PSYCHOLOGICAL FACTORS MEASURED IN THE DIFFERENTIAL OFFICER BATTERY. U.S. Army Behavior and Systems Research Lab, Technical Research Report, No. 1173, 1976.

[22]House, Robert H. and Rizzo, John R., Role Conflict and Ambiguity as Critical Variables in a Model of Organizational Behavior. ORGANIZATIONAL BEHAVIOR AND HUMAN PERFORMANCE, 1972 (June) Vol. 7(3), 467-505.

[23]Neuman, I., N. M. Abrahams and Githens, W. H., THE VALUES OF JUNIOR OFFICERS: THE RELATIONSHIP BETWEEN CAREER VALUES AND RETENTION. U.S. Naval Personnel and Training Research, Laboratory Research Report, 1972, No. 72-23.

[24]O'Gorman, J. G., NEED ACHIEVEMENT AND OFFICER SUCCESS: THE VALIDITY OF LYNN'S ACHIEVEMENT MOTIVATION QUESTIONNAIRE. Australian Army Psychological Research Unit, Research Report, 1972, No. 5/72.

[25]Gould, R. B., REPORTED JOB INTEREST AND PERCEIVED UTILIZATION OF TALENTS AND TRAINING BY AIRMEN IN 97 CAREER LADDERS. U.S.A.F. Human Resources Laboratory Technical Report, No. TR-72-7, 1972 (Jan.).

[26]Girod, M., G. Allaume, and P. Billard. Assessment of the Human Potential of French Army Recruits, and Research on Their Motivations. PSYCHOLOGIE FRANCAISE, 1973, Vol. 18 (2-3), 133-145.

[27]Herrell, James M., Birth Order and the Military: A Review from an Adlerian Perspective. JOURNAL OF INDIVIDUAL PSYCHOLOGY, 1972, 28(1), 38-44.

the generalized application of the findings. This is often a limitation in some journal articles and other brief reports of empirical studies. Of course this problem is not unique to studies of military personnel.

Because of the volume of irrelevant and nearly relevant literature on the potential usefulness of worker characteristic data to the specific needs of the reviewer, it is necessary to define one's interest precisely and limit the scope of a review to the selected worker characteristic variables pertinent to the purpose of a study. The focus of this section has been limited to the type of worker characteristics that have been used by the Marine Corps.

The Worker Characteristics Inventory, previously used by the Office of Manpower Utilization as a part of task analysis, is a check list with the following categories of items:

1. Physical capacities - items 1-10, e.g., back and shoulder strength

2. Psychomotor abilities - items 11-18, e.g., eye-hand coordination

3. Sensory - items 23-34, e.g., taste and perceptual capacities

4. Cognitive skills - items 35-45, e.g., arithmetic

5. Temperaments - items 46-58, e.g., emotional stability

Rather than attempt to list the relationships that have been found among specific worker characteristics within these areas and specific criteria, each category of worker characteristics is evaluated in terms of the potential usefulness of variables for improving classification, assignment and utilization in the Marine Corps.

Physical Capacities

It has already been argued that job demands of physical capacities must be determined by trained analysts, rather than based on the varying opinions of job incumbents. But what can be said about the effectiveness of practices and processes in assessing an individual's physical capacities? It appears that there are fewer and fewer jobs in the Marine Corps where sheer physical strength is appropriately a limiting factor in selection. Many heavy labor jobs have been eliminated through technology, or changed in ways which permit any healthy person to perform the job. Unless the purpose is to select physically handicapped people, physical capacity limits appear to be useful primarily as a screening device for those jobs that require extraordinary physical capacities. Fleishman studied the structure and measurement of physical fitness, and has identified a number of fitness factors which might be described as gross bodily movements. Examples include trunk strength, gross body coordination, gross body equilibrium, extent of flexibility,

dynamic flexibility, explosive strength, static strength, and dynamic strength.[28] However, these factors are not intended to predict job performance and are not generally useful for that purpose. Even in jobs where exceptional physical capacities are required, other types of abilities, psychomotor, sensory, etc. are generally also required, and complicate or negate many predictions of job performance. Some reasons for this are mentioned in the next section.

Psychomotor Abilities

The most important point emerging from the literature dealing with motor tests and attempts to relate measures of psychomotor abilities to job performance is that motor functions tend to be highly specific. Research using correlations and factor analysis of large numbers of tests have failed to reveal broad group factors in the manner of those found for mental functions.[29] Fleishman[30,31] and his associates[32,33] have conducted extensive research in this area and have identified the following major factors:

Control Precision: Ability to make fine, highly controlled but not overcontrolled muscular adjustment--important in the rapid and accurate operation of controls by hand, arm, and foot movements.

Multi-Limb Coordination: Ability to coordinate gross movements requiring the simultaneous use of more than one limb in any combination.

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[28]Fleishman, Edwin A., THE DIMENSIONS OF PHYSICAL FITNESS: THE NATIONWIDE NORMATIVE AND DEVELOPMENTAL STUDY OF BASIC TESTS. Technical Report No. 4, 1962, Yale University, Contract Nonr 609(32), Office of Naval Research. Also see: Fleishman, E. A., THE STRUCTURE AND MEASUREMENT OF PHYSICAL FITNESS, Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1965.

[29]Anastasi, Anne, PSYCHOLOGICAL TESTING (3rd ed.). New York: MacMillan & Co., 1968.

[30]Fleishman, E. A., Dimensional Analysis of Psychomotor Abilities. JOURNAL OF EXPERIMENTAL PSYCHOLOGY, 1954, 48, 437-454.

[31]Fleishman, E. A., Dimensional Analysis of Movement Reactions. JOURNAL OF EXPERIMENTAL PSYCHOLOGY, 1958, 55, 438-453.

[32]Fleishman, E. A., and Ellison, G. D., A Factor Analysis of Five Manipulative Tests. JOURNAL OF APPLIED PSYCHOLOGY, 1962, 46, 96-105.

[33]Fleishman, E. A., and Hempel, W. E., Jr., Factorial Analyses of Complex Psychomotor Performance and Related Skills. JOURNAL OF APPLIED PSYCHOLOGY, 1956, 40, 96-104.

Response Orientation: Ability to select the appropriate response under highly speeded conditions--identified in complex coordination tests in which each pattern of signals requires a different choice of controls and direction of movement.

Reaction Time: Speed with which an individual is able to respond to a stimulus when it appears--found to be independent of specific response required and of whether the stimulus is auditory or visual.

Speed of Arm Movement: Speed with which gross arm movements can be made, regardless of precision.

Rate Control: Ability to make continuous anticipatory motor adjustments relative to changes in speed and direction of a moving target--the common factor in pursuit and tracking tests.

Manual Dexterity: Ability to make skillful, well-controlled arm-hand movements in manipulating fairly large objects under speed conditions.

Finger Dexterity: Ability to make skillful, controlled manipulations of small objects, involving primarily finger movements.

Arm-Hand Steadiness: Ability to make precise arm-hand positioning movements where strength and speed are minimized.

Wrist-Finger Speed: Traditionally called "tapping", this ability is best measured by paper-and-pencil tests requiring rapid tapping of the pencil in relatively large areas.

Aiming: A narrowly defined ability measured chiefly by paper-and-pencil dotting tests which require subject to place a dot accurately and rapidly in each of a series of small circles.

These factors of tested psychomotor abilities do not correspond to applications in industry or in other occupations in any systematic way. In validity studies of measures involving psychomotor abilities, it is necessary to differentiate between simple motor functions tests and job simulations, where performance in the simulation exercise approximates performance in the criterion task to be predicted. The Complex Coordination Test of the Air Force, for example, has shown fair validity, which was sufficient to improve the prediction of performance in pilot training. For most jobs, however, the use of complex custom-made tests or job simulations is not practical. This is due to the large number of different tests required--one for each performance activity, or criterion, for each job.

Commercially available motor functions tests measure very simple motor functions. The validity of these measures for most criteria is limited. They are sometimes useful in predicting performance on routine

assembling and machine operating jobs,[34] but as jobs become less repetitive, intellectual and perceptual abilities become more important. This further reduces the usefulness of psychomotor measures in more complex jobs.

Among the reasons that physical and psychomotor skills measures may not be useful in industry (and in the Marine Corps) may be summarized as follows:[35]

1. Unjustified extrapolation from physical abilities to job performance. Physical and psychomotor skills may be very important as minimum requirements for performance but become less important as higher levels of these abilities are assessed. A linear relationship between a physical characteristic and task performance is often assumed or implied when these measures are used. However, published research indicates that physical abilities above the required minimum do not predict higher performance. Other variables such as individual performance goals tend to become more important.

2. Psychomotor abilities tend to be highly unique. A person with an above-minimum score on "foot-eye-hand coordination" may demonstrate excellent performance as a jeep driver but poor performance as a sewing machine operator, or vice versa, independent of practice and training effects. It may appear logical that "foot-eye-hand coordination" is a single skill but the evidence indicates otherwise. The psychomotor abilities of the human body are extraordinarily numerous, complex, and specific, and they interact with the effects of training, mental abilities and other variables.

3. Psychomotor abilities may change with practice. Evidence from Fleishman[36] and others document changes in demonstrated psychomotor skills as a function of practice. In studies of the eye-hand-foot coordinations required for piloting a plane, both the number and nature of factors identified at different stages of practice varied. In the early stages of training, non-motor factors entered into performance together with motor factors. The relevant non-motor factors included spatial orientation, visualization, mechanical experience, and perceptual speed. The importance of intellectual factors decreased with practice, however, and the importance of motor factors increased. In the final stages of practice the only common factors

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[34]Ghiselli, Edwin E., The Validity of Aptitude Tests in Employee Selection, PERSONNEL PSYCHOLOGY, 1973 (Winter), Vol. 26(4), 461-477.

[35]Guion, Robert M., PERSONNEL TESTING, New York: McGraw-Hill Bood Co., 1965.

[36]Fleishman, Edwin A. and Ellison, G. D., A Factor Analysis of Five Manipulative Tests. JOURNAL OF APPLIED PSYCHOLOGY, 1962, 46, 96-105.

which retained significant weights were control precision, speed of arm movement, and a factor specific to the method of measurement. Similar results have been obtained in analysis of other complex motor tasks. In sum, the argument is that, as training progresses, the nature of the task changes. As a result, the ability requirements for task performance may change considerably over the training period. Practice effects may occur over "training periods" of years.

4. Reliability of measures of psychomotor abilities. Some of the simple homogeneous motor tests have reasonably high reliabilities, but in general, psychomotor tests do not attain reliabilities as high as other types of tests. The reliability of psychomotor tests is not improved as much by increasing the length of the tests as with most intellectual tests because the different portions of such tests may not measure precisely the same functions.[37]

5. Physical and psychomotor abilities are not as well catalogued as intellectual abilities. The need for establishing synthetic validity for relationships between particular motor skills and specific areas of job performance have not been followed by sufficient research and documentation to meet Marine Corps job analysis needs. Perhaps only in the area of vision testing and to a lesser extent dexterity testing, has enough research been conducted to demonstrate relationships among particular psychomotor skills and task behaviors required by Marine Corps jobs. More research is needed.

6. Lack of imagination in devising or choosing specific instruments for specific jobs. It has been suggested that where job analysis indicates the usefulness of measurable differences in psychomotor abilities for selection, imagination can be used to develop work sample tests or apparatus tests what will reflect the psychomotor aspects of the criterion task.[38] The concept of synthetic validity, where relationships between elements of abilities and elements of tasks are generalized from job to job, has not been applied very successfully. One reason, it seems, is that there are few ingenious, practical measurement approaches in the middle ground between those which are too elemental and basic, e.g. a measure of "finger movement", and measures which simulate the job effectively but are too expensive and elaborate for general use, e.g. the use of flight simulators in pilot testing.

7. Lack of understanding where physical and psychomotor measures may be useful. Modernization, automation, and affluence have changed

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[37]Fleishman, Edwin A. and Ellison, G. D., A Factor Analysis of Find Manipulative Tests. JOURNAL OF APPLIED PSYCHOLOGY, 1962, 46, 96-105.

[38]Guion, Robert M., PERSONNEL TESTING, New York: McGraw-Hill Book Co., 1965.

the nature of most jobs in the United States, and nowhere is technological advancement more apparent than in many areas of the military occupations. Jobs which required the skilled physical manipulation of instruments, tools, or weapons have been replaced with jobs of machine tending, monitoring, or management. The number of jobs in the Marine Corps where "back and shoulder strength", for example, is required at levels above that of almost all Marines has been greatly reduced by technological innovations. If the Marine Corps undertakes to induct, classify or assign the physically impaired or persons who fall below certain minimum physical and coordination abilities, then measurement of this type of worker characteristic will be useful, but only for those jobs where measurable differences in physical or psychomotor abilities can be shown to predict task performance. Again, the general implication is that people with merely adequate physical and psychomotor abilities may perform as well or better than persons with superior physical and psychomotor abilities because of special motivation or other factors.

Sensory Capacities

Almost all of the findings, problems, and limits to appropriate application of measures of psychomotor abilities apply equally well to sensory capacities. Sensory functions were among the earliest topics investigated in laboratories of experimental psychology. Much of the research in this area today comes from engineering psychologists in "human factors" laboratories. The principal purpose of this field of research is to design equipment for maximally effective use by human operators. Methods used in this field, including empirical tests, pilot tests, and observation and interview by trained specialists appear to be more appropriate for analyzing sensory capacities in job demands than the earlier OMU worker characteristics inventory with its reliance upon ratings by job incumbents. One of the chief uses of sensory capacities tests in the selection process is in the identification and placement of military and industrial personnel. Most of the available tests are therefore oriented primarily toward detecting inadequacies in personnel being assessed. Standardized tests for assessing individual differences in sensory capacities are primarily limited to vision and hearing. A large volume of research documents the negative effects of sensory handicaps on quantity and quality of output, turnover, accidents, spoilage and waste of materials, and other similar criteria.[39] The Marine Corps' present practice of screening out individuals with sensory handicaps during induction examinations would appear to reduce to a minimum the incidence of job performance problems traceable to inadequate sensory capacities.

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[39]See Tiffen, Joseph, and McCormick, Ernest J., INDUSTRIAL PSYCHOLOGY, Chapters 6 & 18, Englewood Cliffs, N. J.: Prentice-Hall, Inc., 5th ed., 1965.

Cognitive Skills

Items from OMU's formerly used Worker Characteristics Inventory that fall into this "Cognitive Skills" category include arithmetic, general memory, and mechanical ability. There is no evidence in the literature supporting the use of importance ratings of cognitive skills by job performers to determine the characteristics required for effective job performance. The traditional methodologies for task analysis, such as the Department of Labor methodology, utilize scales of cognitive abilities, but the ratings are made by trained analysts based upon observations and interviews. These ratings provide a basis for selecting aptitude tests for validation studies in which test scores are correlated with job performance criteria. Of course, only tests which demonstrate validity for a specific job should be used in selection for that job.

Temperaments

For lack of a better label, the last twelve items in the OMU Worker Characteristics Inventory are referred to as temperaments in this report. There are several types of characteristics which do not seem to fit neatly into any single category. "Concentration" is usually classified as a mental skill; "dependability" is a behavioral pattern; "emotional stability" would seem to be based upon psychological factors, while "personal appearance" could be based on several non-psychological, non-mental factors. In psychometric terminology, any instrument designed to measure emotional, motivational, interpersonal, and attitudinal characteristics, as distinguished from abilities, is labeled a personality test.

The literature on the development of personality or temperament inventories reveals several common procedures for formulating, assembling, selecting, and grouping items. The major approaches are those based on content or construct validity, empirical criterion keying, factor analysis, and personality theory. A detailed review of these approaches, with examples is found in Anastasi's book.[40]

It appears that the development of items included in OMU's Worker Characteristics Inventory were based on content validation, that is, the items were drawn from statements by job performers, task analysis data, or rational judgments by task analysts.

Many personality inventories use the self-report method. The person who completes the inventory is asked to report voluntarily, or rate himself on various traits. The results are usually transformed into "scales" consisting of clusters of items. The scale scores then

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[40] Anastasi, Anne. PSYCHOLOGICAL TESTING (3rd Ed.), New York: MacMillan, 1968, Chapter 17.

form a "profile" which can be interpreted by a psychologist for use in appraisal, selection, assignment, or vocational counseling.

It is important to understand that the appropriate application of the self-report method is limited with regard to both item content and use of the data. A general guide holds that while it is appropriate for allowing a person to communicate his interests and temperaments for counseling purposes, it may not be appropriate or adequate for assessing mental, physical, or moral capacities for selection purposes. For selection purposes, these capacities are assessed best by tests, not inventories. Any voluntary self-report device is more appropriately considered an inventory, rather than a test, in spite of claims by sellers of personality inventories that their instrument's purpose is "masked" allowing the user to gain information from the job applicant without the possiblitity of faked or unreliable responses.

The literature evaluating personality inventories indicates that faking, malingering, response sets, ambiguity and other problems are far more acute with personality measures than in aptitude testing. Although psychologists are continually trying to improve these instruments, the implication, in view of the documented limitations in current personality inventories for selection purposes, is that, as Anastasi has said, they may be "recognized as intrinsically crude instruments and their application restricted accordingly."[41]

It is recognized that the personality items included in the Worker Characteristics Inventory were not used in classification and assignment decisions, but only for job demands analysis. The inventory was not a self-report method in the truest sense, because the persons completing the inventory were not asked to report their own traits, but rather to rate traits in terms of the degree to which they were required by the job. However, the literature on task analysis indicates that the more widely accepted approach holds that these judgments should be based on the work of trained job analysts. It is our position that such judgments should not be based uncritically on the potentially biased and varied ratings assigned by job incumbents. Opinions of incumbents may be useful as supplemental information to help the analyst understand perceptions and attitudes toward various tasks. However, the analyst is responsible for making a determination of temperament demands based primarily upon a logical consideration of the behavioral demands in task activities.

D. DETERMINING THE PURPOSE AND METHOD OF WORKER CHARACTERISTICS ASSESSMENT

The preceding review of various categories of worker characteristics

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[41] **Anastasi, Anne,** PSYCHOLOGICAL TESTING (3rd Ed.), New York: MacMillan, 1968, p. 462.

represents a selective sampling of the relevant literature in these areas. It points to the general conclusion that each category of worker characteristic has its particular limits, uses, and measurement problems. The method of measurement that works best for one type of worker characteristic, e.g., temperaments, may be quite different from the best approaches for measuring another dimension of human characteristics, e.g., physical capacities. Rather than search for "the one best way" to determine job requirements in these fundamentally different dimensions, the appropriate approach is to begin by stating the specific objectives of any measurement effort in terms of desired results. The purpose of assessment of worker characteristics should be clarified at the outset, because the purpose of assessment should determine the types of characteristics to be assessed and the choice of methods. Then the methods, along with the planned use of the data, should in turn determine who within the Marine Corps should have responsibility for these measurement activities.

The importance of explicitly determining the application of any dimension of worker characteristics data before collecting it becomes more clear when consideration is given to the varied uses of worker characteristics information. Some of the purposes and applications of recognized worker characteristics assessments and job analysis data are discussed below.[42]

Job Restructuring

Situations can develop where job incumbents must perform activities that are significantly above or below their levels of competence. Also, workers may assume or be given duties essentially unrelated to the primary content of their jobs. Over time, a mismatch emerges, especially in dynamic environments or teamwork jobs. Inappropriate matching of workers to jobs frequently contributes to high turnover rates, weakened morale, and slowing of skills development. The specification of required worker characteristics, especially aptitudes, should allow OMU to design and adapt jobs to permit a better matching of available human resources to developing Marine Corps tasks and objectives.[43]

Qualifications Standards Development

It is not uncommon for entry and promotional requirements to reflect artificial and largely irrelevant criteria, including assump-

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[42]See Wilson, Michael, JOB ANALYSIS FOR HUMAN RESOURCE MANAGEMENT: A REVIEW OF SELECTED RESEARCH AND DEVELOPMENT, Manpower Research Monograph No. 36, U.S. Dept. of Labor, 1974, pp. 2-3.

[43]For a basic guide for use in restructuring job systems, see: U.S. Dept. of Labor, Manpower Administration, A HANDBOOK FOR JOB RESTRUCTURING, Wash., D.C.: U.S. Government Printing Office, 1970.

tions regarding appropriate sex roles. These requiremtnts may screen out persons who are capable of doing a job and, at the same time, allow less appropriate candidates to slip through. A common tendency is to over-generalize and over-use worker characteristics and aptitude test scores. The assupmtion that these data can predict every kind of performance in every kind of situation has not been demonstrated by research and is unrealistic. An empirical examination of relationships among degrees of worker characteristics and performance on specific tssks can help to correct and adjust qualifications standards, and facilitate fuller utilization of human resources.

Training Program Development

With the changing nature of many Marine Corps jobs, it is not possible to assume that training needs identified in the past are appropriate for the present and the future. Training activities may often be overly general and may be based upon intuitive perceptions or values of what is required for effective job performance. Task statements can clarify the specific skill and knowledge requirements for the job, and facilitate the development of realistic behavioral objectives for the training program.

Test Development

If tests are to have sound validity, they must measure the factors that determine levels of performance on a job. The tests should identify those individuals who are most capable of performing the job well. As new tasks and activities emerge, tests must be adapted to measure those aptitudes and worker characteristics related to the new task performance requirements. In the private sector, the landmark Supreme Court Decision in 1971,(Griggs versus Duke Power Company), ruled that any test or other employment requirement that cannot be proved to be job-related, and which discriminates unfairly among applicants, is in violation of the Civil Rights Act of 1964.[44] "Unfair" discrimination is defined as the use of any employment practice,that limits, classifies, or segregates people because of their sex, race, religion, or national origin.

Preparation of Accurate Job Descriptions

As responsibilities and activities of organizational units develop and change, even job descriptions which were once accurate become obsolete and often misleading to those who rely on them. Up-to-date

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[44]For a good discussion of this as well as EEOC, OFCC requirements in general, see: Lockwood, Howard C., Equal Employment Opportunities, Ch. 4.7 , pp. 4-245-4-287, in Yoder, Dale, and Heneman, Herbert G., Jr., STAFFING POLICIES AND STRATEGIES, Vol. 1, ASPA HANDBOOK OF PERSONNEL AND INDUSTRIAL RELATIONS, Wash., D.C.: The Bureau of National Affairs, Inc., 1974.

job descriptions, complete with personnel sepcifications are essential in providing enlisted men, officers, and staff with a common understanding of the expectations and responsibilities of their jobs and the jobs of other Marines with whom they interact. An understanding of mutual expectations is vital to the integration of efforts toward organizational goals.

Performance Evaluation

Evaluation of performance is one of the most important management functions, yet it is often regarded as a necessary evil and handled in a casual or routine manner. Ever worse, the results often are not translated into corrective or constructive action. Properly utilized, however, performance evaluation can be an important instrument for insuring that management decisions and policies are properly implemented throughout the organization. A major problem, however, is a lack of job-related criteria. Often, performance standards are overly general and ambiguous, especially those which refer to worker characteristics. Lists of "dimensions" such as "initiative" and "reliability" are commonly perceived and rated differently by different people. More important, these characteristics may not be related to acceptable job performance. The establishment of results-oriented, job-related evaluation criteria is potentially the most important benefit of the process of analysing the process, content, and worker requirements of jobs.

Career Planning and Counseling

Both officers and enlisted men should be able to make more informed decisions and intelligent plans for their careers if they have an awareness of or access to detailed information on the content, qualifications, training and skill requirements of every job in the Marine Corps. Rather than depend entirely on others in the Marine Corps for making classification and assignment optimally effective, an individual can help himself and the Marine Corps in making his own career decisions when he has a knowledge of his abilities and the qualification requirements of alternatives and opportunities open to him in the Marine Corps.

Affirmative Action Program Planning

A job analysis that includes a thorough examination of relationships between actual worker characteristics such as sex, race, or national origin and actual, measured job performance is the basis for sound affirmative action, and broad acceptance of these actions. The literature documents the history of practices and assumptions that have resulted in unfair and needless rejection of persons capable of performing a job. However, the fact that progress is being made in this area does not mean that any person can perform any job.

Sound affirmative action planning includes precautions against placing undertrained or underprepared persons on jobs for the sake of

statistical "equal opportunity" or appearances. Premature placements of this kind have sometimes resulted in poor performance which has confirmed stereotypes, created resentment by fellow workers, and increased frustration and discouragement for the person placed in the job. An analysis of relationships among worker characteristics and performance of specific tasks is basic if this problem is to be avoided, while simultaneously eliminating arbitrary unjustified barriers to job placement. Information from job analysis can be used effectively in gaining initial acceptance of affirmative action goals in specific occupational areas.

The position of the Federal Government on the use of job analysis as a basis for validation studies and for affirmative action compliance is given in a document issued by the Equal Employment Opportunity Coordinating Council. This Council includes representatives from the Department of Justice, the Department of Labor, the Equal Employment Opportunity Commission, the U.S. Civil Service Commission, and the Commission on Civil Rights. The EEOCC points out that in job analysis, the factual bases for the determination of worker characteristics requirements must be documented:[45]

> "A required element of any validation study is a systematic and comprehensive analysis of the job for which the test is to be used. The analysis must be based upon (1) the duties performed by the incumbents on the job, (2) the level of difficulty at which the duties are performed, (3) the circumstances and conditions under which the duties are performed, and (4) those duties which are critical i.e., those which must be performed competently if the job is to be performed in a satisfactory manner. The job analysis should describe on what bases any working conditions were determined to be critical and on what bases duties were determined to be critical, such as the proportion of time spent on the respective duties, their levels of difficulty, their importance, or their frequency of performance. If a duty which occupies a high proportion of time is not deemed critical, the reasons therefore must be set forth. For those duties which have been determined to be critical pursuant to clause (4) above, the job analysis should set forth which knowledges, skills, abilities, and

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[45]Equal Employment Opportunity Coordinating Council, "Uniform Guidelines on Employee Selection Procedures," Discussion draft Aug. 23, 1973, pp. 7-8. Also see: U.S. Equal Employment Opportunity Commission, Guidelines on Employee Selection Procedures, FEDERAL REGISTER, 1970, 35, 12333-12335; and, U.S. Department of Labor, Employee Testing and other Selection Procedures, FEDERAL REGISTER, 1971, 36, 19307-19310.

other worker characteristics are required for successful job performance.

The requirements for a job analysis set forth herein are not intended to specify a particular method of job analysis. Any professionally recognized method of job analysis is acceptable if it is comprehensive and otherwise appropriate for the specific validation strategy used. For example, it is recognized that some methods of job analysis provide direct identification of the knowledge, skills, abilities, and other worker characteristics necessary for successful job performance by an analysis of work process, rather than specific job duties. In any case the factual bases for the determination of the identified knowledges, skills, and abilities, and other worker characteristics must be documented."

It may be argued that although the "Uniform Guidelines" do not apply to the Marine Corps, the relationships among job analysis, test validity, and equal opportunity should be of concern to the Marine Corps. Types of test validity and their relationships to job analysis methods and EEOC and OFCC rules are summarized below.

There are two basic classifications for procedures for validating tests or other hiring standards, empirical and rational.[46]

Empirical Methods of Validation. Empirical validation procedures are required by the EEOC Guidelines and the OFCC Testing Order when feasible. There are two types of empirical validation, predictive and concurrent.

In the predictive validation design, in its purest form, all applicants are tested prior to employment, but their scores are not used in making the employment decision. Later, these scores are correlated with a measure of training or job success to see whether those with high scores do substantially better than those with low scores. This is the most elegant method scientifically, but it is seldom used in its purest form because it is costly and slow, and is rarely feasible for a small organization. However, this is the primary method recommended for use in the Marine Corps because of its scientific rigor, and the fact that most OFs contain an adequate number of Marines for application of the method.

In the method of concurrent validation, present employees are tested and the scores of those high in performance on the job are compared with those who are low, to see whether there are significant differences.

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[46]This discussion of types of test validity has been adapted from, Stone, C. Harold, and Ruch, Floyd L., Selection, Interviewing and Testing, Ch. 4-4, p. 4-125 (also, see p. 4-126), in Yoder, Dale, and Heneman, Herbert G., Jr., STAFFING POLICIES AND STRATEGIES, VOL. I, ASPA HANDBOOK OF PERSONNEL AND INDUSTRIAL RELATIONS, Wash., D.C.: The Bureau of National Affairs, Inc., 1974.

Despite its shortcomings, this method has been widely used by the U.S. Employment Service.

Rational Validity. There are two rational methods of validation permissible under the EEOC Guidelines when empirical validation is not feasible. These are the methods of content and construct validity. Both require a thorough knowledge of job demands based upon careful job analysis.

Content validity involves a systematic examination of the job and the test content to determine whether the test contains a sampling of the knowledge, skills, and behavior required for successful job performance. Thus, a typing test is a "content-valid" measure to use in hiring stenographers, although it does not cover the whole domain of stenography. A shorthand test, another content-valid measure, can help to give a more complete sampling of an applicant's stenographic skills when used with a typing test.

The construct validity of a test refers to the extent to which the test measures a "theoretical construct" or trait. Examples of theoretical constructs are verbal ability, space visualization, and perceptual speed, to name just three aptitudes that are frequently job related. When, for example, careful job analysis shows that workers must read blueprints, a test of space visualization is valid as part of the employment procedure. There are many other constructs which have been shown to be job related.

Taylor has concluded that, "Whereas content validity may be achieved by studying only tasks performed in an occupation or class, construct validity requires a complete job analysis...," and,

> "Construct validity can be demonstrated by showing a complete record of the process that was employed, including a list of the tasks identified in the job analysis, the list of abilities required to perform these tasks, the reasons for not attempting to measure all of the necessary abilities, the nature of the tests used and the evidence that suggested their use, and their reliabilities when used. All of this information should be retained in the agency's files as long as that examination plan is in use."[47]

Both of the rational methods of validation are dependent upon judgment. Like human judgments in other areas, judgments relative to the degree of content or construct validity depend upon the training and experience of the judge.[48]

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[47]Taylor, Vernon R., Test Validity in Public Personnel Selection, PUBLIC EMPLOYMENT PRACTICES BULLETIN, No. 2, Chicago, Ill.: Public Personnel Association (now the International Personnel Management Association), 1971.

[48]Stone and Ruch, Ibid., p. 4-125.

Other Applications of Job Analysis and Worker Characteristics Assessment

Job analysis methods can be used to identify environmental job demands and safety hazards, including current and potential dangers in job situations. These in turn may imply certain worker characterisitics requirements. Among the other areas where worker characterisitcs information has been useful are wage and salary administration, management information systems, human resource utilization programs, and job development or retraining for physically handicapped veterans.

To summarize, there are numerous purposes or applications for worker characteristics information obtained through job analysis. These may be viewed as different means or approaches to the goal of obtaining greater benefit in classification and assignment.

E. THE VALUE OF A SYSTEMS APPROACH TO USING WORKER CHARACTERISTICS DATA IN CLASSIFICATION AND ASSIGNMENT

For better or worse, it is a fact that the responsibility for many of the applications discussed above is assigned to separate organizational units in the Marine Corps. The size of the Marine Corps and the specialized tasks involved in classification and assignment appear to make it impractical to have a more centralized approach to classification and assignment. Nevertheless, the relationships and interactions among some of the listed applications should be recognized, and wherever practical, efforts should be made to coordinate actions. Without this coordination, improvements in practices in one area of application frequently lead to problems in other areas. This phenomenon is often called "suboptimization," meaning that one department or group optimizes its goals at the expense of another. Concepts from Systems Theory may be useful in preventing problems of this type. The simplest guideline holds that before any change in our part is made the consequences of that action for other components of the system should be explored.

No specific recommendation for the Marine Corps in this regard is made at this time. However, it appears that, as a generalization, some benefit to classification and assignment can result if the several groups which have responsibilities in the nine application areas discussed in the preceding section work to improve communications with each other.

A further point concerns the dynamic nature of the applications. Rather than view them as finite tasks which can be accomplished and left alone, the management of goals in each area should be viewed as a continuing, developing process.

F. THE IMPORTANCE OF JOB PERFORMANCE MEASUREMENT TO USING WORKER CHARACTERISTICS DATA IN CLASSIFICATION AND ASSIGNMENT

A final point concerns the need for developing criteria that measure job performance. When the Systems Theory perspective is applied to the

use of worker characteristics data in classification and assignment, it becomes apparent that efforts to improve classification and assignment are dependent upon the ready availability of productivity measurement and worker performance evaluation. Without effective measures of worker performance it is impossible to evaluate accurately the effectiveness of various job analysis methodologies, or any other procedure that uses worker characteristics data in classification and assignment. Wilson explains the relationship between job performance measures and the evaluation of various job analysis methodologies in this way:

> "A major reason for conducting an analysis, certainly a major argument for gaining support for it among top managers, is the presumed beneficial effect that the resulting job restructuring alternatives or training curricula will have on organizational productivity. Without reliable performance evaluation criteria, it is impossible to document these effects or even to identify them accurately."[49]

The effectiveness of a job analysis methodology, then, should ultimately manifest iteself in improvements in job performance. These desired improvements can be detected and documented primarily through job performance measures.

Unfortunately, criterion development for performance evaluation has been neglected in most organizations, including the Marine Corps. Task performance by enlisted men is evaluated almost entirely through the simple proficiency and conduct ratings provided by their superiors. These general measures may not be adequate in providing the kind of comprehensive information needed for the important dimensions of job performance. Multi-dimensional feedback on performance is useful not only in the evaluation of job analysis methodologies but for other purposes.

The Health Services Mobility Study identified several uses for valid performance evaluation data:

1. To enable an institution to evaluate the quality of its own work, covering individuals within the institution.

2. To compare groups of employees. For example, the success of an educational ladder paralleling a job ladder can be measured by applying performance evaluation instruments to incumbents trained in the new program. A comparison can then be made between the two groups.

3. To evaluate the adequacy of occupational training programs. If curriculum objectives are derived from task activities, the adequacy of individual programs can be ascertained by reference to the performance of the tasks in actual work situations.

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[49] Ibid. p. 49.

4. To determine when students have successfully reached standards of completion of program requirements in laboratory or clinical work independent of time requirements. If performance evaluation were used to determine student readiness to pass from laboratory to clinical or to ascertain when clinical work was successfully completed, there might be greater safety to the patients who are involved in the clinical practice. Performance evaluation would make it possible to save on laboratory and/or clinical training time when not needed by proficient students or to prescribe additional training for students performing below par.

5. To be used alone or in conjunction with proficiency or equivalency examinations to evaluate an individual's readiness to be accepted with advanced standing in existing programs, into job titles, or to sit for licensure or certification examinations.

6. To be used to validate test items in proficiency examinations. Currently, incumbents' scores on proficiency test items are used to validate test items, but the items are not tested for job relevance. Performance evaluation instruments can be used to validate test items, and thus to generate job relevant test items.[50]

With slight modification and interpretation, these same uses can be meaningful to the Marine Corps. It is therefore recommended that the Marine Corps explore the potential of job analysis in the related areas of productivity measurement and worker performance evaluation.

The need for job-related performance measures is equally as important as the need for job related selection/promotion procedures. They are two sides of the same coin, so to speak. An awareness of the uses and benefits of meaningful performance evaluation data is the necessary first step toward creating a system in which the primary or "ultimate" purpose of the job analysis process, including the collection of worker characteristic data, can be realized.

G. SUMMARY: CONSIDERATIONS IN CHOOSING AMONG ALTERNATE METHODS OF MEASURING WORKER CHARACTERISTICS REQUIREMENTS.

This section of the report discusses alternative approaches to the assessment of worker characteristics. The first portion of the section briefly describes the major methods which represent alternative approaches to task analysis, with emphasis on the assessment of worker characteristics. Choice among task analysis methodologies should be based upon a realistic assessment of an occupation's needs. For example, in the human services, the Functional Job Analysis (FJA) or Career Opportunities Research and

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[50] Health Services Mobility Study, Ibid., pp. 2-32.

Development Scales (CORD) might be used. For industrial jobs, the "Things" scale from the Department of Labor Methodology could be adapted by adding more specific items. This should work well as the primary tool in analysis. Other specific scales for worker characteristics and other task aspects should be adapted and used to supplement the "Things" scale. Data should be rated on as many dimensions as applicable to maximize potential uses at the local level. The method of developing behavioral requirements, used by the Chicago Police Department, is seen as having major advantages over other techniques for studying Marine Corps jobs under combat conditions.

If the highest priority purpose of the task analysis is increasing upward mobility and greater utilization of human resources, Primoff's job element approach may be appropriate. If the objective is to improve utilization of women and others in jobs involving environmental and physical capacities demands, Hanman's "Specific Method"[51] could serve this objective. (A discussion of the Specific Method follows in Section V).

If time, expertise, training, and money are no object, the methodology developed by the Health Services Mobility Study is the best choice. It represents the most sophisticated, comprehensive, accurate and complex set of procedures yet developed for general task analysis purposes, with an emphasis on the purpose of upward mobility and career development. Of course the actual scales developed by HSMS would not be transferable to occupations outside the health field. Rather, the "method" means the approach to developing these scales.

These judgmental statements are offered only as examples of the kind of matching of methods to needs and objectives that could be made by OMU, and, if done, should be re-evaluated and updated on a continuous basis. This report does not include an attempt to recommend "the best" methods for all of the needs and objectives which may be determined in the Marine Corps. Any "cookbook" approach could do more harm than good. What is needed in the choice of tools for the analysis of jobs in an occupational category, including the assessment of worker characteristics, is a realistic assessment of the occupation's needs, and the determination of practical, measurable objectives for the specific analysis effort.

It is also considered important that the OMU staff study and become conversant with the various job analysis methodologies. This could aid in evaluating the assets and limitations as well as the unique character of different approaches that make them appropriate for specialized objectives. Study of Michael Wilson's relatively recent monograph could serve as a starting point for such a review.[52] A number of the references to research reports cited in this section of our report, as well as some of the discussions of job analysis methods and uses, were drawn from Wilson's work.

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[51] Hanman, Bert, PHYSICAL CAPACITIES AND JOB PLACEMENT, Stockholm, Sweden: Nordisk Rotograryr, 1951.

[52] Ibid.

Similarly, the needs of an occupation and the objectives of analysis should have greater weight in determining the categories of worker characteristics to be assessed. Physical demands, for example, may be required in certain blue collar jobs. These are generally not significant in most desk jobs. It is pointed out in this section that the nature of the worker characteristics requirements to be analyzed limits the choices of assessment techniques. Physical capacities, temperaments, aptitudes, and other categories of worker characteristics are associated with different assessment techniques.

A review of nine distinguishable applications for task analysis data, including worker characteristics requirements, is presented. It is suggested that the Marine Corps examine practices and objectives in each area on a continuing basis for possible changes and improvements. Also, arguments for applying a systems perspective to the use of worker characteristics data in classification and assignment are discussed briefly. The final portion of this section argues for greater attention to the need for developing evaluation criteria for jobs in the Marine Corps. A major reason for conducting job analysis, or for improving classification and assignment, is to obtain benefits in job performance and effectiveness. Without adequate criteria of performance evaluation, the benefits of various job analysis methodologies cannot be accurately assessed.

A central conclusion in this chapter is that there is no single best method for analyzing jobs, tasks or worker demands. Asking for a single "best" method may be compared to asking what is the "best" vehicle to transport Marines -- a jeep, tank, truck, train, bus, ship, or plane? Of course there is no single best approach for the variety of needs, objectives, applications and practical limitations that exist for various occupations and situations.

Several factors need to be considered and evaluated in choosing among alternate methods of assessing working characteristics. Among those are:

1. Determine specific needs in the occupations to be analyzed and develop objectives for use of the resulting data. Uses of data that should be considered include job restructuring, determining qualifications for entry, updating training, and the other applications mentioned earlier.

2. Establish criteria for the evaluation of the task analysis method in the areas where improvements are desired. Task analysis, including the assessment of worker characteristics requirements, is of little ultimate value unless its impact shows up in measures of productivity and worker performance evaluation. Unless more attention is given to the need for criterion development in these related areas, the value of job analysis programs will be limited on this account.

3. Choose the method, tools, and processes of analysis which best fit the objectives for utilization of the data. Experts at OMU should be aware of the variety of alternative methods available with the specialized advantages and limitations of each method. For worker characteristics analysis, the nature of the characteristics, e.g. aptitudes, temperaments, should also influence selection of the method.

4. Weigh the "utility" of a proposed project ("project" refers to an application of a particular method for specific objectives). It is, of course, recognized that consideration of the limits of available time, funds, training of analysts, and other resources is integral to the choice of method. Some procedures will cost more, but the expected benefits, in terms of more efficient and equitable manpower utilization, can also be much greater.

5. Consider ways in which Marine Corps units responsible for various applications of task analysis data, e.g. job restructuring, classification, assignment and training, can better share information and assist each other in accomplishing their respective objectives. Access to information regarding plans, results, and implications of task analysis efforts, including worker characteristics requirements, should be open to other Marine Corps units who requests it. Bureaucratic organizations typically protect themselves by guarding or filtering information carefully. But OMU could benefit from using all appropriate means to promote the use of its information and products by other groups in the Marine Corps. Service schools and agencies involved in classification and assignment of Marines would seem to be among those who could benefit from such information.

6. Consider the consequences for other areas of proposed actions based on task analysis data.

Inherent in these suggestions are: (1) OMU should be responsible for assessing worker characteristics requirements of jobs in the Marine Corps, and (2) OMU can and should maintain a repertoire of tools, approaches and methods for conducting task analysis, and become adept at selecting the right tool for a given job. This does not mean that every staff member should be trained in every technique. But one or more should keep abreast of developments in job analysis methodology, and be competent to match techniques to occupational needs and specific objectives of analysis.

One of the purposes of this report is to make recommendations of methods to be used for needs and objectives identified in this study. It would not be wise or feasible to recommend that OMU undertake several new directions and methodologies at once. Rather, a planned, systematic program for expanding the repertoire of the OMU staff's tools, methods and planned applications of task analysis data is viewed as important. As a beginning in this direction, a new approach to the assessment of certain worker characteristics is recommended. The proposed methodology, "Hanman's

Specific Method" and its potential benefits to classification and assignment in the Marine Corps are described in the next Section of this report.

The occupational needs and specific objectives that led to the recommendation of Hanman's method concerns the utilization of women, and in a few cases, some men in certain occupational classifications. There are several OF's in the Marine Corps where environmental and physical capacities demands, or assumed demands, have resulted in restrictions for entry of some Marines into OF's, or MOS's within the OF's. Greater utilization of Marines in physically demanding occupations can be achieved. However, a method is needed that can identify physical demands with reasonable precision and will prevent assignment of a Marine to a task that is beyond his or her physical capacities, and at the same time, make maximum utilization of personnel resources. Hanman's Specific Method is recommended for use by the Marine Corps for achieving this purpose.

Although Hanman's method is relevant only to jobs in which environmental and physical capacities are important, the benefits of using the method in classification and assignment could be significant. It should be of special value in consideration of assignment of Women Marines to OF's formerly closed to them.

It is also considered important that the Marine Corps establish criteria for evaluating the use of the Specific Method. The number and sex of persons placed on formerly restricted jobs should be recorded. Also, evaluations should be made of the job performance of Marines so placed.

V

HANMAN'S SPECIFIC METHOD

Following review of a number of systems for measuring the physical demands and environmental conditions of jobs, we have concluded that Hanman's Specific Method merits consideration for trial by the Marine Corps. At first glance, Hanman's method may not appear to differ radically from other checklist methods of appraising worker characteristics required for jobs. Job analysts, trained in the use of Hanman's terminology and definitions, assess a job using a worksheet that lists forty-nine physical and thirty-one environmental demands. Hanman selected these eighty job-demands factors largely on a rational basis in his effort to achieve a balance among standards of comprehensiveness, specificity, and comparability with terminology used in other systems. The eighty factors were adapted by Hanman in his development of five different forms, each of which is designed for a specific purpose. These forms are reproduced in Appendix F.

The specific method derives its name from the manner in which judgments are made and recorded. Rather than assuming a common interpretation by all analysts of general terms on a scale, e.g. "little", "moderate", or "very high" levels of a physical capacity, Hanman devised a system whereby physical capacities are translated into units of time for most functions, or through other specific and objective measures. The majority of judgments are based upon the hours and/or portions of an hour required for performance of an element or a task in a duty or a job. The job analyst does not need to judge the quantity of strength or ability associated with an element or task demand, but only the length of time that each particular physical capacity must be utilized. For example, a single figure, "1", entered on Hanman's Physical Demands Analysis Worksheet in the appropriate space indicates that a job requires lifting 25 lbs. intermittently for a total of one hour each shift.

It might be argued that job analysts would be limited or unable to communicate their best judgment by this method of recording their evaluations. However, Hanman's data and experience with the method indicate that exactly the opposite is the case. Job analysts, once familiar with the new measurement system, are able to record and convey their best judgments to others in a clearly understandable manner. Judgments are quantified and can be readily interpreted by almost anyone in terms of specific job demands and behaviors. This is the principle advantage of the method over other methods of evaluating and describing physical demands of jobs.

A. OPERATIONAL CHARACTERISTICS OF THE SPECIFIC METHOD

Hanman built other features into his method that are designed to make resulting data more specific as well as more reliable and useful.

His book[48] includes a manual with complete instructions for using the "Specific Method", from installing the program to application of the derived data in various types of job redesign efforts. Key points from his manual are summarized in this section. More complete details are given in Appendix F.

Use of the specific method in task analysis is relatively straightforward, and not operationally different from other rating methods, except in terms of definitions. However, Hanman exphasizes the direct linkage of the method to the process of personnel evaluation. The Specific Method is conceptualized as a complete system, in which the processes of task analysis, personnel evaluation, and classification and assignment are directly linked. All three processes are based on the same eighty factors, using specified time-oriented judgments and the terminology and definitions provided in the manual.

When an individual is evaluated for purposes of classification and assignment, a physician (or other qualified specialist) uses a worksheet listing the same eighty job factors that are used by job analysts in rating importance of physical and environmental factors. This list is shown on Forms 1 and 3 in Appendix F. At the end of a routine physical examination, the physician completes Form 3.

In filling out the form, the physician leaves blank all of the items where no limits in the individual's capacity to perform during an entire eight-hour shift are evident. For example, if the individual is judged capable of staying on his feet for an eight hour shift, Item 25, standing, is left blank. Where there are limits, those limits are expressed in specific, interpretable terms. For example, if a Marine is judged capable of moderate lifting by the physician, the physician must judge what he considers to be a safe upper limit in pounds the individual can lift, e.g. fifty pounds. This judgment is expressed by recording a zero in the spaces next to Items 5 and 6, lifting intermittently 51-100 lbs. and 100+ lbs.,respectively.

The physician must judge a safe maximum time which the individual may be required intermittently to lift up to fifty pounds during a normal eight hour shift. If he decides on one hour, he enters a "1" in the appropriate space. This simple entry would then indicate to anyone that the Marine is judged capable of lifting up to fifty pounds safely for a total of one hour during the work day.

The data recorded on Form 3 by the physician are directly comparable to data gathered by analysts and recorded by them on Form 1. Classification and assignment becomes a quick, unambiguous check to determine whether a particular set of job demands exceeds the limits of an individual's physical capacities. In this way physical capacities and limits are used to screen out only those individuals who fall below minimum physical capacity requirements. This simplifies the process

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[48]Hanman, Bert, PHYSICAL CAPACITIES AND JOB PLACEMENT, Stockholm, Nordisk Rotogravyr, 1951; distributed by John de Graff, Inc., New York.

of making inferences from physical traits to job performance, a common source of error in other approaches.

Another characteristic of the Specific Method is the provision in the manual of a set of operational definitions for each of the eighty job factors (See Appendix F). If necessary, these definitions may be modified to match the special requirenents of Marine Corps jobs. Although the definitions were developed in industrial settings and thoroughly tested, they may require only minimal modifications for Marine Corps use. An important standardization factor in the Hanman method is that all who perform task analysis or personnel evaluation use the same manual of operational definitions of potentially ambiguous job factors, such as "waiting time".

Another characteristic of the specific method is its flexibility. Hanman developed five forms that are included with his book and reproduced in Appendix F.[49] These are designed to meet all of the needs for processing physical capacity data in a non-computerized industrial organization. The five forms are designed for these purposes: 1. Job analysis of physical and environmental factors (Form 1), 2. Charting and comparing physical and environmental demands for multiple jobs (Form 2), 3. Assessment of an individual's physical and environmental capacities (Form 3), 4. Summarizing and reporting an individual's qualifications with regard to a specific job or jobs (Form 4), and 5. Request for a job analyst (Form 5). Forms 1 and 3 seem to be most applicable to Marine Corps use, and Forms 2, 4 and 5 could be replaced by other methods if desired.

B. ADVANTAGES AND LIMITATIONS OF THE SPECIFIC METHOD

Many of the limits of the time-based measure of capacities may also operate as important advantages, depending upon what criteria are applied. The first limit, for example, is that the method applies only to physical and environmental demands. Biographical data, previous work experience, training, aptitudes, personality and interest variables, attitudes and other worker characteristics are not included. Studies attempting to link these other worker characteristics to aspects and levels of job performance have had varying success. In general, research reveals few generalities and a myriad of, at best, moderately strong relationships among specific predictors, criteria, conditions, and populations. In view of the tenuous cnd complex nature of relationships among these variables and job performance, the omission of these factors from the instrument could be viewed as an asset rather than a liability. Where their usefulness is established, cognitive and higher level abilities should be measured using other methods.

The Specific Method is not intended to optimize the utilization of

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[49]By permission of John de Graff, Inc., New York.

talents, experience, and abilities for classification and assignment. It is designed to prevent rejection of persons who are capable of coping with the physical and environmental demands of jobs. The method should be of special value to Marine Corps' efforts to remove what may be unrealistic barriers to classification and assignment of women Marines.

Hanman reports that use of his forms has had positive influence on production rates and worker morale, and has contributed to a decrease in rates for labor turnover, accidents, and sickness. The most dramatic benefits from use of the method are revealed by statistics on turnover rates among disabled workers, a finding not generally applicable to the Marine Corps. To the extent that the Marine Corps' present induction physical examination and other processes screen out persons who are not in acceptable physical condition, the value of any method that focuses on physical capacities is attenuated. Data on the reliability, validity and utility (costs/benefits) of the application of the method, if adopted by the Marine Corps, should be collected periodically, and adjustments made as necessary.

The assumption is made that use of the Specific Method will enable Marine Corps physicians to make more effective judgments about how well an individual can cope with the physical and environmental demands of a job than by use of other methods of determining these capacities. Physicians may argue that they are unable reliably to estimate the length of time an individual would be able to perform under various conditions. And, quantifying their judgments gives the appearance of precision when there is insufficient basis for such precision.

The method's time-based measure may also be questioned because it does not allow the physician to record his reservations or any limits which are not expressed easily in terms of endurance. It is conceivable that physicians may resort to padding their judgments under conditions of uncertainty, or some may make judgments that are consistently more conservative or biased more in one way than others. Similar problems and questions are inherent in any rating scale. The Specific Method, as a form of rating scale, is subject to many of the problems common to any rating method, such as halo error, leniency error, and malingering.

An important value of the Specific Method is that it is designed to overcome or reduce errors related to the most serious limitation of rating scales -- interpretation of terms and scores. There is little room for misinterpretation of the physician's report about an individual when the Specific Method is used. Hanman reports that with only brief experience, physicians come to appreciate this clarity.

The underlying issue is: At what point should crucial inferences be made from observed physical capacities to job performance criteria? Should inferences about job performance be based on judgments of the examining physician, the task analyst, empirical findings, personnel officers, computers or some combination of all of these? The challenge

is to devise a method of determining minimal performance levels that are acceptable in terms of criteria of maximum utilization of personnel and prevention of assignment of Marines to jobs beyond their physical capacities.

In the Specific Method, the classification and assignment of an individual in relation to his/her physical capacities is determined by information provided by ratings made by the examining physician. The primary burden of inference is placed upon the physician.

In most other methods, the judgment of a third party is required at some point to relate physical examination data to job performance. For example, a personnel specialist may have the final responsibility for determining if a woman Marine with "good", but not "excellent", arm strength as reported in the physical examination, should be eligible for an assignment that requires carrying heavy objects. In borderline cases, the Specific Method can make a difference by reducing the number of "errors". It is especially useful in reducing unnecessary rejections based upon physical capacity. Every person should be eligible for a job unless the physician's limits are exceeded.

The task analysis aspect of the method is less judgmental than the process of evaluating an individual's capacities. However, some training is required for both analysts and physicians. Task analysts assigned to use the Specific Method, and medical personnel who use it for individual evaluations, must first become familiar with the definitions of the eighty job factors and the method of recording judgments. A few days of orientation, study, and practice in application of the method is usually sufficient. Appendix F contains details of the method, definitions of factors, and other explanatory information upon which training in understanding and applying the method can be based.

VI

SUMMARY AND RECOMMENDATIONS

Worker characteristics lists included in earlier task inventories as a part of Marine Corps task analysis were assembled and reviewed. Intercorrelations among ratings by Marines of worker characteristic job demands were computed using data from two OF's which differed both in job content and level of technology. The results of analyses of data from these two OF's indicate a high degree of intercorrelation among ratings of diverse worker characteristics demands. One surprising result was that the intellectual and high level skills were rated as being required to a greater extent by Marines in the lower technology OF than those in the higher technology OF. It is evident that job performers were not differentiating those characteristics which are logically related to job performance from those that are not. As a result, it is recommended that the approach used in OMU's previous Worker Characteristics Inventory not be followed in future measurement of worker characteristics.

The process of analyzing task activities, distinguishing actual requirements in the behaviors and characteristics observed, and making inferences from traits to job performance, is a demanding and complex task. How well it is accomplished is affected by the method used and the competence of the analysts. It is recommended that future judgments of the worker characteristics required for effective job performance be made by analysts trained in observation and interview techniques. The evidence indicated that judgments based upon the ratings of job incumbents may be unreliable and misleading. Even when judgments are made by trained analysts, their work should be verified.

Certain types of worker characteristics, including aptitudes, can best be assessed by using tests. After the analysts identify any aptitudes which appear to be related to job performance, these potential requirements should be validated by comparing aptitude test scores with job performance criteria. Only aptitude measures which demonstrate effectiveness in a continual program of systematic validation should be used in classification and assignment decisions.

Studies at the Naval Personnel and Development Center in San Diego indicate that a number of aptitude test batteries currently utilized in assignment to training in service schools could be improved considerably by using different combinations of existing tests. It is recommended that the results of this research be used as a basis for establishing new test batteries for service school selection in those cases where different test combinations than those now used have demonstrated higher validities.

In order to avoid problems of changes and lowered test validities that may occur over a span of time, it is recommended that the Marine Corps conduct periodic validity studies to monitor the value and use of its aptitude tests in every area where they are used as part of a decision-making process. Changes in conditions can affect test validities, whether these are developments in technology, instructional methods, methods of evaluating performance, changes in test conditions, or changes in the nature of new Marine Corps recruits.

Section IV of this report provides a description of alternative methods and techniques for analyzing jobs, with special emphasis on the assessment of worker characteristics requirements. A variety of techniques are available, which range from general to specialized, from simple to sophisticated, and which differ in purpose. Comprehensive approaches such as the Health Services Mobility Study methodology, have demonstrated higher accuracy and other benefits over other approaches, but they require considerably more extensive time and staff training. The Section mentions practical as well as theoretical considerations involved in choosing a method for a specific purpose.

There is no single best method of job analysis or worker characteristics assessment. The choice of method should be based upon a realistic consideration of the needs of the occupation or occupational area to be analyzed, and upon specific objectives for improvement in that area. Nine uses of analysis data are described, with the suggestion that practices and objectives in these nine application areas be re-examined periodically. Several factors which affect the ultimate usefulness of task analysis data are discussed, including performance criteria. It is recommended that the Marine Corps explore the potential of job analysis in the related areas of productivity measurement and worker performance evaluation.

It is our opinion that the assessment of worker characteristics requirements of jobs can best be determined by OMU analysts who are adequately trained in observation and interview techniques. If OMU is to meet the developing needs in Marine Corps occupations on a continuing basis and accomplish designated objectives in these job areas, it must maintain expertise and awareness of the general and specialized analytical tools and approaches that are available. Further, it must develop the capacity to use whatever techniques are most appropriate when specialized occupational needs or objectives are determined.

We are recommending a method of measuring worker characteristics that is new to most OMU personnel. Our recommendation is based, in part, on our appraisal of the need for greater utilization of both men and women in occupations where special environmental or physical capacities are required. The technique, Hanman's Specific Method, is most useful for jobs requiring rigorous physical capacities standards. It is expected to provide significant benefits to classification and assignment in these occupations. The method will require orientation and training of OMU staff, physicians who conduct induction physical examinations, and coordination of these groups.

Finally, it is recommended that, if used, the effectiveness of the Specific Method in improving classification and assignment be evaluated. The number and sex of Marines who are placed in jobs formerly closed to them should be recorded, and their job performance should be measured on all important dimensions. OMU should establish criteria for all of its job analysis efforts, evaluate the usefulness of various tools and methodologies employed, and use these appraisals as a basis for future decisions.

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APPENDIX A

Worker Characteristics Inventory
Used By the Office of Manpower Utilization,
As Part of Task Analysis Inventories Administered
By OMU Until Early 1974.

APPENDIX A

WORKER CHARACTERISTICS

The performance of any job requires you to have and use certain basic qualities known as "worker characteristics". Listed are statements which describe a number of these worker characteristics.

The "I DO" column in the answer booklet should be interpreted as "MY JOB REQUIRES" for worker characteristics. If your present job requires any of the characteristics listed, mark the "I DO" (MY JOB REQUIRES) block for that characteristic. Use the TIME SPENT column to indicate the extent that your job requires the characteristic according to the following scale:

1. Required very little
2. Required to a below average degree
3. Required slightly below average
4. Required to an average degree
5. Required slightly above average
6. Required to an above average degree
7. Required very much

DO NOT mark the TRAINING column.

Keep in mind that your answers should show the demands of your MOS job and NOT your personal ability or the demands outside your job. TURN TO PAGE 17 IN THE GREEN ANSWER BOOKLET AND CONTINUE MARKING ANSWERS STARTING WITH 501 WHICH CORRESPONDS WITH THE NUMBERING OF THE QUESTIONNAIRE.

501. Finger, hand, wrist, and forearm strength - Squeeze, bend, pull, twist, turn, or grip objects.

502. Upper arm strength - Lift, swing, push, pull, carry, or throw objects.

503. Back and shoulder strength - Lift or move objects with the back and shoulders or swing heavy tools to strike objects.

504. Leg, foot and ankle strength - Lift objects using knee action, operate pedals with pressure, grip or brace with the knee, or walk, stand, or kneel with a load.

505. Work fast for a few minutes.

506. Work fast for an hour.

507. Work fast for many hours.

508. Heavy, tiring work for a few minutes.

509. Heavy, tiring work for an hour.

510. Heavy, tiring work for many hours.

511. Finger movement - Move fingers freely and quickly.

512. Hand and arm movement - Move hands and arms quickly.

513. Foot and leg movement - Move feet and legs quickly.

514. Eye - hand coordination - Must look where you place your hand or reach for objects.

515. Foot - eye - hand coordination - Must look where you place your feet and hands.

516. Move both hands separately - Move one hand in one direction and the other hand in a different direction.

517. Foot - eye coordination - Must look where you place your feet.

518. Foot - hand coordination - Move feet and hands at the same time.

519. Height - Is height a factor in your job?

520. Weight - Is weight a factor in your job?

521. Unpleasant working conditions - Work in hot, dirty, noisy areas.

522. Dangerous working conditions - Work where you might get hurt.

523. Good eyes.

524. Color vision - Distinguish between colors.

525. Estimate size.

526. Estimate number of objects.

527. Estimate speed - Guess the speed of moving objects.

528. Estimate quality - Tell how good something is by looking at it.

529. Form perception - Describe shape of objects.

530. Good hearing.

531. Good smell.

532. Touch ability - Evaluate something by feeling it.

533. Muscle sensitivity - Tell how heavy or hard an object it by pushing, pulling or lifting it.

534. Taste - Tell items apart by taste.

535. Detailed memory - Remember detailed information.

536. General memory - Remember orders, instructions, procedures, plans, etc.

537. Oral memory - Remember what others say to you.

538. Written memory - Remember written directions.

539. Memory for people - Remember names and faces.

540. Arithmetic - Ability to add, subtract, multiply, and divide.

541. Planning ability - Organize ideas and determine what should be done.

542. Mechanical ability - Understand how tools and machines operate.

543. Oral expression - Present ideas clearly when talking.

544. Written expression - Present ideas clearly in writing.

545. Attention span - Keep track of many things at once.

546. Adaptability - Adjust easily to new plans and ideas.

547. Decision making.

548. Initiative - Do what has to be done without others telling you to do it.

549. Tact.

550. Personal appearance.

551. Concentration.

552. Emotional stability - Maintain self control and calmness at all times.

553. Deal with public - Meet and deal with the general public, military and civilian.

554. Teamwork.

555. Leadership.

556. Dependability - Produce results on or before the time someone else needs them.

557. Physical courage - Do what must be done even though you may receive bodily injury.

558. Moral courage - Do what you think is right, regardless of what may happen to you.

APPENDIX B

Correlations Among Ratings of Worker Characteristics
And Aptitude Area Test Scores

Ratings Were Made by Enlisted Marines in
OF 33 (Food Service), OF 70 (Aviation Operations),
And OF 71 (Air Delivery) Based Upon Their
Judgment of Importance of Each Worker
Characteristics in Performance of Their Jobs.
Only Correlations Significant at the $P \leq .05$
Level Are Recorded On Tables B - 1 and B - 2.

BEST AVAILABLE COPY

	Verbal	Arith. Reas.	Pattern Anal.	Classif. Inv.	Mechanical Apt.	Clerical Speed	Infantry	Arm., Art., Eng.	Electronic	General Maint.	Motor Maint.	Clerical	General Tech.	Finger/Hand Steadiness	Upper Arm Strength	Back & Should. Strength	Leg, Ft., Ankle Strength	Work Fast-Few Minutes	Work Fast An Hour	Work Fast-Many Hours	Hvy., Tiring Wrk-Few Min.	Hvy., Tiring Work-An Hour	Hvy., Tiring Wrk-Many Hour	Finger Movement	Hand & Arm Movement	Foot & Leg Movement	Eye-Hand Coordination	Foot/Eye/Hand Coordination	More Both Hands Separately	Foot/Eye Coordination	Foot/Hand Coordination	Height	Weight	Unpleasant Wrk Conditions	Dangerous Wrk Conditions	Good Eyes	Color Vision
Verbal		.22	.40	.19	.22	.24	.37	.38	.31	.43	.27	.66	.78	.23																						
Arith. Reas.	.22		.40	.26	.21	.36	.47	.22	.19	.23	.21	.27	.74								.16							.19							
Pattern Anal.	.40	.40		.42	.19	.17	.56	.33	.43	.59	.42	.30	.51						.17				.17	.15		.16									
Classif. Inv.	.19	.26	.42		.25		.94	.23		.31	.29		.29																						
Mechanical Apt.	.22	.21	.19	.25		.17	.29	.38	.26		.28		.30		.20	.18					.19									.16		.15				
Clerical Speed	.24	.36	.17		.17		.31	.22		.31	.30	.86	.45								.17		.18									.18	.21			.17
Infantry	.37	.47	.56	.94	.29	.31		.33	.21	.44	.39	.32	.55				.15				.16															
Arm., Art., Eng.	.38	.22	.33	.23	.38	.22	.33		.47	.44	.73	.38	.44	.25				.25		.23						.20									
Electronic	.31	.19	.43		.26		.21	.47		.69	.50	.47	.31																						
General Maint.	.43	.23	.59	.31		.31	.44	.44	.69		.79	.63	.42									.20													
Motor Maint.	.27	.21	.43	.29	.28	.30	.39	.71	.50	.79		.38	.38	.16																					
Clerical	.66	.27	.30			.86	.32	.38	.47	.63	.38		.61																			.20			
General Tech	.78	.74	.51	.29	.30	.45	.55	.44	.31	.42	.38	.61																				.19			
Fgr./Hand/Wrist	.23							.25			.16				.76	.47	.42	.41	.46	.50	.35	.33	.30	.31	.47	.27	.35	.39	.26	.33	.44	.32	.24	.36	.35	.28	.24
Forearm Streng.															.76	.68	.52	.44	.54	.48	.53	.49	.50	.35	.57	.40	.39	.53	.30	.47	.51	.47	.37	.33	.38	.25	.30
Upper Arm Strength					.20										.68		.51	.39	.48	.52	.50	.57	.65	.34	.47	.39	.35	.47	.42	.48	.52	.47	.44	.32	.37	.17	.29
Back & Shoulder Strength					.18										.47	.68		.51	.39	.48	.52	.50	.57	.65	.34	.47	.39	.35	.47	.42	.48	.52	.47	.44	.32	.37	.17	.29
Leg, Ft., Ankle Strength						.15									.42	.52	.51		.52	.50	.49	.52	.51	.50	.32	.52	.48	.42	.53	.44	.50	.60	.43	.50	.32	.31	.23	.38
Work Fast-Few Minutes							.25								.41	.44	.39	.52		.72	.57	.62	.45	.40	.48	.57	.58	.46	.46	.36	.51	.64	.43	.46	.42	.55	.32	.43
Work Fast-An Hour															.46	.54	.48	.50	.72		.73	.52	.50	.50	.49	.50	.57	.44	.53	.36	.46	.57	.37	.49	.37	.53	.37	.42
Work Fast-Many Hours			.17				.23								.50	.48	.52	.49	.57	.73		.53	.61	.59	.39	.52	.61	.44	.49	.48	.47	.62	.43	.48	.49	.55	.38	.47
Hvy., Tiring Wrk-Few Minutes				.19	.17	.16									.35	.53	.50	.52	.62	.52	.53		.73	.68	.37	.56	.50	.36	.48	.44	.57	.53	.54	.58	.41	.39	.23	.35
Hvy., Tiring Work-An Hour	.16								.20						.33	.49	.57	.50	.45	.50	.61	.73		.79	.38	.44	.46	.33	.52	.49	.51	.57	.40	.56	.41	.42	.26	.38
Hvy., Tiring Work-Many Hours						.18									.30	.50	.65	.49	.40	.50	.59	.68	.79		.33	.40	.41	.36	.48	.54	.50	.52	.43	.56	.41	.40	.20	.28
Finger Movement			.17												.31	.35	.34	.32	.48	.49	.39	.37	.38	.33		.63	.62	.50	.40	.48	.38	.49	.29	.38	.39	.47	.47	.38
Hand & Arm Movement			.15												.47	.57	.47	.52	.57	.50	.52	.56	.44	.40	.63		.74	.61	.58	.59	.55	.69	.50	.45	.42	.49	.39	.44
Foot & Leg Movement															.37	.40	.39	.48	.58	.57	.61	.50	.46	.41	.62	.74		.55	.58	.55	.53	.66	.43	.43	.40	.51	.33	.44
Eye-Hand Coordination			.16				.20								.35	.39	.35	.42	.46	.44	.44	.36	.38	.36	.50	.61	.55		.63	.61	.57	.48	.39	.39	.18	.49	.20	.24
Foot/Eye/Hand Coordination															.39	.53	.47	.53	.46	.53	.49	.48	.52	.48	.40	.58	.58	.63		.55	.84	.72	.50	.49	.28	.47	.18	.29
Move Both Hands Separately	.19														.26	.30	.42	.44	.36	.36	.48	.44	.49	.54	.48	.59	.55	.61	.55		.54	.58	.49	.51	.22	.39	.34	.37
Foot/Eye Coordination					.16										.33	.47	.48	.50	.51	.46	.47	.57	.51	.50	.39	.55	.53	.57	.84	.54		.73	.62	.55	.32	.56	.17	.29
Foot/Hand Coordination															.44	.51	.52	.60	.64	.57	.62	.53	.57	.52	.49	.70	.66	.48	.72	.58	.73		.62	.61	.47	.55	.34	.47
Height					.15	.18						.19	.32	.47	.47	.43	.43	.37	.43	.54	.40	.43	.29	.50	.43	.39	.50	.49	.62	.62		.67	.41	.45	.36	.48
Weight						.21						.20	.24	.37	.44	.50	.46	.49	.48	.58	.56	.56	.38	.45	.43	.39	.49	.51	.55	.61	.67		.37	.43	.32	.34
Unpleasant Wrk. Conditions													.36	.33	.32	.32	.42	.37	.49	.41	.41	.41	.39	.42	.40	.18	.29	.22	.32	.47	.41	.37		.56	.32	.32
Dangerous Wrk. Conditions													.35	.38	.37	.31	.55	.53	.55	.39	.42	.40	.47	.49	.50	.49	.47	.39	.56	.55	.45	.43	.56		.33	.41
Good Eyes													.28	.25	.17	.23	.32	.37	.38	.23	.26	.20	.47	.39	.33	.20	.18	.34	.17	.34	.36	.32	.32	.33		.79
Color Vision						.17							.24	.30	.29	.38	.43	.42	.47	.35	.38	.28	.38	.44	.44	.24	.28	.37	.29	.47	.45	.34	.37	.41	.75	
Estimate Size													.24	.29	.30	.43	.41	.46	.50	.29	.42	.28	.40	.45	.48	.29	.37	.41	.36	.59	.46	.43	.35	.48	.66	.70
Estimate No. Of Objects													.23	.32	.34	.44	.39	.40	.48	.34	.46	.34	.42	.51	.42	.31	.35	.46	.40	.58	.41	.45	.40	.47	.59	.72
Estimate Speed						.22					.18	.16		.20	.31	.30	.25	.30	.32	.24	.33	.36	.33	.29	.35	.23	.37	.54	.43	.49	.51	.58	.27	.36	.39	.43
Estimate Quality													.25	.26	.18	.34	.34	.37	.38	.34	.43	.25	.44	.41	.34	.40	.42	.40	.42	.37	.32	.44	.36	.49	.50	.46
Form Perception														.23	.16	.35	.35	.38	.39	.32	.38	.30	.38	.41	.41	.22	.34	.44	.33	.46	.46	.42	.22	.38	.54	.51
Good Hearing													.19	.26	.30	.33	.29	.37	.34	.25	.30	.24	.35	.35	.31		.25	.41	.28	.48	.50	.43	.37	.29	.63	.51
Good Smell													.25	.26	.23	.29	.29	.30	.32	.18	.24	.16	.41	.34	.32	.34	.29	.37	.25	.30	.35	.32	.24	.28	.57	.51
Touch Ability					.15								.26	.33	.32	.30	.32	.37	.39	.25	.28	.25	.50	.43	.36	.39	.26	.43	.22	.31	.30	.32	.20	.34	.48	.46
Muscle Sensitivity													.23	.36	.41	.36	.30	.38	.45	.30	.35	.41	.39	.46	.41	.34	.38	.48	.40	.47	.43	.53	.21	.33	.35	.41
Taste													.40	.39	.33	.29	.31	.34	.37	.20	.29	.24	.43	.37	.31	.38	.38	.35	.34	.33	.26	.32	.20	.34	.51	.46
Detailed Memory													.20	.35	.29	.32	.37	.38	.30	.32	.33	.29	.50	.38	.37	.31	.29	.39	.28	.36	.40	.40	.19	.33	.57	.51
General Memory				.19									.19	.29	.27	.29	.22	.22	.21	.22	.26	.25	.45	.34	.22	.20	.19	.37	.21	.30	.35	.38	.23	.21	.56	.46
Oral Memory													.23	.26	.26	.26	.27	.23	.29	.22	.33	.26	.45	.34	.26	.46	.31	.38	.31	.32	.24	.39	.23	.38	.42	.52
Written Memory													.17	.20	.17	.28	.33	.25	.22	.22	.28		.57	.36	.32	.41	.29	.33	.27	.29	.24	.37	.28	.39	.48	.46
Memory for People						.23									.20	.30	.30	.20	.20	.25	.33	.25	.43	.19	.24	.35	.34	.45	.41	.37	.35	.47	.22	.34	.31	.41
Arithmetic Reasoning	.16													.20	.26	.40	.17	.17	.25	.23	.35	.29	.45	.32	.26	.38	.30	.39	.26	.31	.20	.35	.21	.22	.43	.53
Ability	.19		.15				.19					.18	.39	.41	.35	.40	.41	.34	.24	.24	.31	.27	.49	.49	.43	.44	.42	.37	.39	.45	.31	.43	.34	.45	.45	.51
Mechanical Ability							.25						.27	.35	.30	.39	.40	.32	.32	.29	.35	.28	.46	.48	.42	.45	.50	.44	.48	.50	.30	.40	.18	.36	.34	.41
Oral Expression							.20						.31	.33	.30	.39	.40	.32	.27	.31	.42	.31	.21	.44	.37	.49	.40	.40	.38	.45	.31	.38	.19	.41	.33	.44
Written Expression													.18	.22	.25	.32	.40	.35	.37	.39	.46	.36	.48	.41	.46	.43	.50	.48	.45	.49	.36	.47	.22	.44	.37	.44
Attention Span	.17		.23		.15		.25						.29	.26	.27	.32	.39	.34	.45	.32	.33	.36	.43	.45	.39	.53	.42	.44	.45	.37	.30	.39	.22	.49	.41	.51
Adaptability Decision Making													.28	.31	.26	.30	.35	.30	.33	.28	.35	.29	.49	.44	.42	.43	.37	.37	.28	.39	.24	.26	.17	.35	.46	.49
Initiative	.21				.16		.32		.19	.19			.31	.27	.17	.28	.30	.29	.33	.20	.24	.19	.48	.40	.34	.47	.36	.36	.33	.32	.24	.28	.17	.38	.48	.49
Tact													.35	.38	.32	.27	.35	.38	.37	.24	.25	.32	.39	.44	.40	.45	.41	.36	.31	.38	.24	.29	.15	.34	.43	.49
Personal Appearance													.20	.26	.29	.30	.39	.37	.39	.31	.37	.36	.45	.37	.39	.30	.32	.31	.31	.41	.29	.37	.31	.39	.43	.49
Concentration					.18								.17	.19	.21	.17	.24	.24	.20	.24	.27	.18	.37	.40	.36	.39	.37	.33	.30	.31	.25	.23	.13	.30	.40	.44
Emotional Stability							.17						.28	.25	.20	.19	.28	.20	.21	.17	.25	.16	.39	.40	.33	.42	.34	.28	.27	.29	.19	.19	.27	.26	.33	.38
Deal With Public							.27						.19	.27	.22	.19	.40	.29	.20	.24	.19	.21	.47	.43	.40	.37	.34	.26	.34	.33	.29	.25	.19	.39	.40	.46
Teamwork													.24	.26	.29	.24	.32	.28	.25		.16	.17	.45	.45	.39	.54	.36	.37	.26	.35	.30	.21		.33	.38	.43
Leadership							.17						.20	.26	.35	.32	.30	.25	.32	.20	.30	.27	.43	.33	.32	.36	.28	.34	.19	.36	.22	.30	.24	.35	.36	.42
Dependability			.19				.30		.21				.24	.21	.22	.32	.27			.16	.18		.29	.32		.30	.22	.25	.24	.26		.25	.31	.19		
Physical Courage							.16							.24	.26	.39	.33	.23	.27	.30	.26	.32	.31	.32	.25	.31	.29	.30	.20	.37	.35	.29	.22	.25	.23	
Moral Courage														.17	.28	.31				.21	.20	.21	.28	.32	.18	.30	.22	.38	.18	.30	.30	.34		.15	.28	
Paygrade				.19					.30		.22																									

TABLE B - 1

Correlations Among Worker Chara
Ratings of OF 33 Marines And Aptit

TABLE B - 1

Correlations Among Worker Characteristics
ings of OF 33 Marines And Aptitude Test Scores

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	Verbal	Arith. Reas.	Pattern Anal.	Classif. Inv.	Mechanical Apt.	Clerical Speed	Infantry	Arm., Art., Eng.	Electronic	General Maint.	Motor Maint.	Clerical	General Tech.	Finger/Hand/Wrist Dexterity	Forearm Strength	Upper Arm Strength	Back & Shoulder Strength	Leg, Ft. Ankle Strength	Work Fast-Few Minutes	Work Fast-An Hour	Work Fast-Many Hours	Hvy., Tiring Wrk-Few Min.	Hvy., Tiring Work-An Hour	Hvy., Tiring Wrk-Many Hours	Finger Movement	Hand & Arm Movement	Foot & Leg Movement	Eye-Hand Coordination	Foot/Eye/Hand Coordination	Move Both Hands Separately	Foot/Eye Coordination	Foot/Hand Coordination	Height	Weight	Unpleasant Wrk. Conditions	Dangerous Wrk. Conditions	Good Eyes	Color Vision
Verbal		.45	.41		.41	.24	.34	.46	.48	.46	.34	.71	.85	.20	.28	.18	.17					.26															
Arith. Reas.	.47		.49		.43	.34	.51	.36	.42	.51	.29	.45	.83										.18														
Pattern Anal.	.41	.49			.24		.37	.36	.54	.68	.29	.35	.53																								
Classif. Inv.							.87		.22		.20																										
Mechanical Apt.	.41	.43	.24			.24	.31	.43	.51	.39	.43	.33	.48																								
Clerical Speed	.24	.34		.24			.34	.21	.18	.25	.20	.83	.34	.23	.30	.26	.20			.17																	
Infantry	.34	.51	.37	.87	.31	.34		.31	.34	.44	.27	.44	.50																								
Arm., Art., Eng.	.46	.36	.36		.43	.21	.31		.53	.52	.73	.41	.49					.22				.18		.19			.17		.18							
Electronic	.48	.42	.54		.51	.18	.34	.53		.70	.57	.52	.54									.20					.24									
General Maint.	.46	.51	.68	.22	.39	.25	.44	.52	.70		.75	.54	.57									.23														
Motor Maint.	.34	.29	.29		.43	.20	.27	.73	.57	.75		.33	.37		.18							.22		.24					.18				.18			
Clerical	.71	.45	.35	.20	.33	.83	.44	.41	.52	.54	.33		.68	.22	.33	.30	.23																	.27	.25	.18
General Tech.	.85	.83	.53		.43	.34	.50	.49	.54	.57	.37	.68		.17	.23																					
Fgr./Hand/Wrist Forearm Streng.	.20					.23					.22	.17		.83	.68	.62	.31	.32	.20	.35	.29	.17		.41	.45	.32	.42	.33	.39	.26	.33	.40	.50	.38	.20	.24
Upper Arm Strength	.28					.30				.18	.33	.23	.83		.77	.72	.32	.26		.38	.35	.27		.46	.51	.39	.48	.34	.44	.28	.39	.47	.48	.51	.30	.35
Back & Shoulder Strength	.18					.26					.30		.68	.77		.74	.33	.39		.43	.38	.26		.39	.44	.32	.48	.27	.41	.26	.35	.39	.55	.53	.20	.38
Leg, Ft. Ankle Strength	.17					.20					.23		.62	.72	.74		.31	.33		.35	.31	.24		.51	.62	.37	.62	.34	.52	.30	.39	.42	.44	.44	.29	.34
Work Fast-Few Minutes								.22					.31	.32	.33	.31		.28	.19	.40	.23	.24		.22	.33	.22	.38	.22	.26	.26	.24	.25		.27	.18	.22
Work Fast-An Hour													.32	.26	.39	.33	.28		.30	.38	.37	.20	.27	.29	.26		.27		.18	.26	.29	.20	.22		.20	
Work Fast-Many Hours						.17							.20				.19	.30		.37	.38	.46	.23			.28		.22	.17	.16	.22					
Hvy., Tiring Wrk-Few Minutes								.18	.20	.23	.22		.35	.38	.43	.35	.40	.38	.37		.45	.48		.34	.27	.40	.40	.37	.39	.40	.31	.27		.24		.33
Hvy., Tiring Work-An Hour	.26		.18										.29	.35	.38	.31	.23	.37	.38	.45		.66	.22	.32	.28	.21	.22	.25	.25	.31	.41	.33	.20	.26		.25
Hvy., Tiring Work-Many Hours		.18						.19			.24		.17	.27	.26	.24	.24	.20	.46	.46	.66			.26	.25	.19		.31		.23				.22		
Finger Movement																		.27	.23		.22			.38	.21	.20			.22	.24						
Hand & Arm Movement													.41	.46	.39	.51	.22	.29		.34	.32	.26	.38		.65	.46	.54	.40	.46	.49	.32	.34	.22	.34	.44	.43
Foot & Leg Movement													.45	.51	.44	.62	.33	.26		.27	.28	.25	.21	.65		.45	.61	.33	.47	.50	.45	.52	.24	.40	.50	.51
Eye-Hand Coordination								.17	.24				.32	.39	.32	.37	.22		.28	.40	.21	.19	.20	.46	.45		.53	.40	.49	.41	.31	.32	.25	.34	.34	.38
Foot/Eye/Hand Coordination													.42	.48	.48	.62	.38	.27		.40	.22			.54	.61	.53		.32	.69	.49	.40	.38	.33	.44	.49	.59
Move Both Hands Separately								.18			.18		.33	.34	.27	.34	.22		.22	.37	.25	.31		.40	.33	.40	.32		.39	.50	.27		.25		.19	
Foot/Eye Coordination		.20			.16		.18					.17	.19	.39	.44	.41	.52	.26	.18	.17	.39	.25		.22	.46	.47	.49	.69	.39		.58	.41	.26	.21	.34	.34	.39
Foot/Hand Coordination													.26	.28	.26	.30	.26	.26	.16	.40	.31	.23	.24	.49	.50	.41	.49	.50	.58		.23	.26		.26	.35	.46
Height													.33	.39	.35	.39	.24	.26	.22	.31	.41			.32	.45	.31	.40	.27	.41	.23		.80	.28	.36		.18
Weight			.22										.40	.47	.39	.42	.25	.29		.27	.33			.34	.52	.32	.38		.26	.26	.80		.30	.33	.21	.22
Unpleasant Wrk. Conditions						.41					.27		.50	.48	.55	.44		.20			.20			.22	.24	.25	.33		.21		.28	.30		.65	.27	.37
Dangerous Wrk. Conditions						.24		.21		.18	.25		.38	.51	.53	.44	.27	.22		.24	.26	.22		.34	.40	.34	.44	.25	.34	.26	.36	.33	.66		.38	.38
Good Eyes											.18		.20	.30	.20	.29	.18							.44	.50	.34	.49		.34	.35		.21	.27	.38		.47
Color Vision													.29	.33	.38	.34	.22	.20		.33	.25			.43	.52	.38	.59	.29	.39	.46	.18	.22	.37	.38	.47	
Estimate Size													.26	.31	.34	.39		.19	.16	.39	.39	.27	.22	.41	.44	.36	.42	.30	.40	.37	.37	.36	.26	.31	.26	.52
Estimate No. Of Objects													.18	.22	.28	.32	.16	.17		.35	.37	.20		.31	.44	.26	.34	.28	.35	.38	.32	.29	.23	.30	.16	.43
Estimate Speed											.21		.23	.27	.32	.25	.22	.19		.28	.23			.28	.40	.16	.42	.28	.31	.34	.30	.24	.27	.35	.24	.45
Estimate Quality													.36	.36	.36	.23	.23		.27	.28	.29	.27		.30		.38	.28	.49	.18	.20	.25		.26	.27	.22	.20
Form Perception													.26	.29	.31	.40	.24	.22	.28	.45	.37	.32		.30	.36	.34	.35	.21	.27	.28	.30	.27	.30	.29	.31	.59
Good Hearing											.18		.33	.37	.34	.37					.20			.39	.39	.28	.38		.20			.18	.20	.37	.48	.39
Good Smell													.38	.40	.45	.43		.26	.21	.20	.45	.25		.25	.42	.21	.31			.20	.21	.33	.27	.18		.45
Touch Ability						.23					.24		.26	.35	.37	.33				.23	.38	.26		.35	.31	.25	.35	.25	.25	.22	.30	.27		.25	.19	.39
Muscle Sensitivity			.20										.38	.37	.37	.36	.27	.17	.28	.33	.31	.23	.21	.39	.42	.34	.36	.30	.33	.37	.35	.38	.19	.30	.24	.47
Taste									.19	.16		.22	.23	.29	.27	.37	.18	.27	.17	.26	.25	.20		.17	.28	.20	.35	.19	.28	.25	.27	.34	.19			.35
Detailed Memory				.36			.27												.25				.17	.28		.31	.18	.22	.18	.19		.17		.17	
General Memory	.20	.34	.20	.19		.25						.30							.20					.18		.33	.26	.16		.17					.23	
Oral Memory	.22			.24		.25						.28							.34			.18		.23		.34	.24								.20	.19
Written Memory				.18		.16						.18							.44			.23	.20			.37	.16	.17			.16				.19
Memory for People					.18				.22	.17									.21			.30				.21			.17					.23	
Arithmetic Planning Ability	.17			.20			.18				.18		.22	.33	.24	.20		.19	.23			.36		.26		.19	.19					.16	.18	.24		
Mechanical Ability				.20		.22		.21	.20		.27		.50	.61	.44	.37	.19	.19		.32	.20	.17		.42	.38	.41	.44	.28	.26	.31	.35	.39	.46	.50	.43	.47
Oral Expression				.33			.21										.21	.19	.30			.17		.23		.19	.19			.23						.23
Written Expression				.34			.21												.33	.24		.19														
Attention Span	.23			.18		.18	.17					.22		.17					.30				.32			.20										
Adaptability				.31			.19									.17		.19						.25		.16		.18	.22			.26		.25	
Decision Making				.25									.18	.24	.29	.21	.16	.33	.26	.30	.25			.40	.25	.21	.26		.18	.35	.26	.34		.23	.20	.28
Initiative				.18		.19	.19						.23				.18		.18				.20	.32	.26	.30	.30				.25		.22	.36	.25
Tact	.20			.20			.17				.18	.18	.20					.17	.24				.33	.24					.27							
Personal Appearance			.17			.17													.23				.22													
Concentration	.22			.21		.18	.21					.23	.23						.29	.25		.22		.28	.22		.26			.19						
Emotional Stability													.17	.20	.16	.24	.33	.27			.20		.21	.35	.35	.25	.35		.32	.32	.33	.28		.36	.35	.28
Deal With Public			.17		.17								.20		.17			.20			.19				.19	.21			.17	.26			.21	.18		.31
Teamwork													.26	.38	.26	.24	.31		.17	.22		.23		.45	.44	.38	.39	.19	.31	.31	.22	.21	.18	.47	.49	.46
Leadership												.17		.27	.18	.21	.22				.22	.18		.30	.28	.24	.29		.21		.19	.22		.28	.34	.28
Dependability	.17	.17		.19			.19						.23			.19			.20	.28	.21		.18	.26	.34	.21	.30	.23				.17		.27	.21
Physical Courage	.19	.19			.20				.20		.24	.19	.42	.47	.19	.33	.20			.17				.43	.48	.23	.45		.36	.34	.31	.36	.24	.40	.37	.40
Moral Courage			.25						.22				.36	.35	.27	.27	.20	.29	.18	.23	.25	.16	.19	.41	.44	.27	.42		.29	.29	.31	.32		.35	.30	.38
Paygrade			.21						.23				.20									.18				.17	.17									

TABLE B - 2

Correlations Among Worker Ch
Ratings of OF 70/71 Marines And A

TABLE B - 2

Correlations Among Worker Characteristics
Ratings of OF 70/71 Marines And Aptitude Test Scores

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APPENDIX C

Validities Of Aptitude Tests Used In The Selection of Navy Enlisted Personnel For Enrollment in Navy Service Schools

Table C - 1

Correlation of Navy Aptitude Test Batteries With Service School Performance

Service School	Present Battery	Validity Coefficient*	Alternate** Batteries	Validity* Coefficient
			CLER	.11
Postal Clerk (PC)	GCT+CLER	.12	ARI+CLER	.07
Electronics Tech A-1 (Great Lakes)	ARI+2ETST	.70	GCT+ARI+ETST	.66
			ARI+MECH+ETST	.65
Communications Tech "0" Branch (CTO)	GCT+ARI	.58	GCT+ARI+ETST	.57
			ARI+ETST	.56
			GCT+ARI+CLER+ ETST	.56
Sonar Tech-Surface (STG)	ARI+2ETST	.68	ARI+CLER+ETST	.67
			GCT+ARI+ETST	.65
Communications Tech "R" Branch (CTR)	GCT+ARI	.34	GCT+ETST	.34
			GCT+ARI+ETST	.34
Aviation Maintenance Administration (AZ)	GCT+ARI	.61	GCT+ARI+ETST	.61
			GCT+ARI +CLER +ETST	.61
			GCT+ARI+CLER +SP+ETST	.61
Trademan-Training Devices Man (TD)	ARI+2ETST	.79	SP+ETST	.80
			ARI+SP+ETST	.80
Aviation Storekeeper (AK)	GCT+ARI	.63	GCT+ARI+ETST	.64
			GCT+ETST	.63
Electronics Tech A-3 Radar (ET)	ARI+2ETST	.52	GCT+ETST	.53
			GCT+MECH+ ETST	.53
			GCT+ARI+MECH+ ETST	.53
			ETST	.53

*Validity coefficients corrected for attenuation by Spearman-Brown Formula.

**For practical predictive purposes it is considered that the slight differences in validity coefficients is not significant.

Service School	Present Battery	Validity Coefficient*	Alternate** Batteries	Validity* Coefficient
Radioman (RM) (San Diego)	GCT+ARI	.50	GCT+ARI+ETST	.51
			GCT+ETST	.50
			ARI+ETST	.50
Quartermaster (QM) (Newport)	GCT+ARI	.61	GCT+ARI+MECH	.62
			GCT+ARI+ETST	.62
Boilerman (BT)	GCT+MECH+SHOP	.55	GCT+MECH+ETST	.56
			GCT+MECH+SP+ ETST	.56
Aviation Machinist's Mate Reciprocal (ADR)	GCT+MECH+SP	.61	ARI+SP	.63
			GCT+SP	.62
			GCT+ARI+SP	.62
Aviation Electrician's Mate (AE)	ARI+2ETST	.64	GCT+ARI+CLER +ETST	.66
			GCT+ARI+CLER+ SP+ETST	.66
Aviation Structural Mechanic-Structures (AMS)	GCT+MECH+SP	.52	GCT+ARI+MECH+ ETST	.54
			GCT+ARI+MECH+ SP+ETST	.54
Aerographers' Mate (AG)	GCT+ARI	.68	ARI+ETST	.70
			GCT+ARI+ETST	.70
			GCT+ARI+CLER+ ETST	.70
			GCT+ARI+CLER+ SP+ETST	.70
Personnelman (PN) (San Diego)	GCT+ARI	.38	ARI+ETST	.40
			ARI+CLER+ETST	.40
			GCT+ARI+CLER+ ETST	.40
Commissaryman/ Steward (CS/SD)	GCT+ARI	.47	GCT+ARI+CLER	.49
			GCT+CLER	.48
			GCT+ARI+CLER + ETST	.48
Avionics (AV)	ARI+2ETST	.71	ETST	.73
			ARI+SP+ETST	.70

Service School	Present Battery	Validity Coefficient*	Alternate** Batteries	Validity* Coefficient
			ARI+MECH+ETST	.55
			GCT+ARI+SP+ ETST	.55
			GCT+ARI+MECH+ SP+ETST	.55
			ARI+MECH+CLER +SP+ETST	.55
			GCT+ARI+MECH+ CLER+SP+ETST	.55
Electronics Tech Communications A-3 (ETN) Treasure Island)	ARI+2ETST	.39	SP+ETST	.43
			GCT+SP+ETST	.43
			GCT+MECH+SP ETST	.43
Communications Tech-"T" Branch (CTT)	GCT+ARI	.60	GCT+ETST	.64
Submarine Quarter-master (SS QM)	GCT+ARI	.58	GCT+ARI+MECH	.62
			GCT+ARI+MECH+ CLER	.62
			GCT+ARI+MECH+ ETST	.62
			GCT+ARI+MECH +CLER+ETST	.62
Interior Communi-cations Electrician (IC)	GCT+MECH+SP	.60	GCT+MECH+ETST	.64
			GCT+SP+ETST	.64
Aviation Ordance-man (AO)	GCT+MECH+SP	.49	GCT+MECH+ETST	.54
			GCT+SP+ETST	.54
			GCT+MECH+CLER +SP+ETST	.54
Aviation Support Equipment Tech-Electrical (ASE)	GCT+MECH+SP	.41	ARI+SP	.46
			ARI+MECH+SP	.45
			ARI+SP+ETST	.45
Hull Tech-A-2 Shipfitter (HT)	GCT+MECH+SP	.47	MECH+SP+ETST	.52
			MECH+ETST	.51

Service School	Present Battery	Validity Coefficient*	Alternate** Batteries	Validity* Coefficient
Fire Control Tech-Phase I (FT) (Great Lakes)	ARI+2ETST	.79	ARI+CLER+SP ETST	.81
			ARI+CLER+ETST	.80
Hospitalman (HM) (Great Lakes)	GCT+ARI	.68	GCT+ETST	.70
			GCT+ARI+ETST	.70
Fire Control Tech-Phase 1 (FT) (Mare Island)	ARI+2ETST	.68	ARI+CLER+ETST	.70
			ETST	.68
			CLER+ETST	.68
Data Processing Tech (DP)	GCT+ARI	.57	ARI+ETST	.60
			GCT+ARI+ETST	.60
			ARI+2ETST	.60
Quartermaster (QM) (San Diego)	GCT+ARI	.64	ARI+ETST	.67
			GCT+ARI+ETST	.66
			ARI+SP+ETST	.66
			ARI+2ETST	.66
Aviation Structural Mechanic-Hydraulics (AMH)	GCT+MECH+SP	.56	ARI+MECH+SP ETST	.59
			GCT+ARI+MECH+ SP+ETST	.59
Polaris Electronics (PE)	ARI+2ETST	.74	ETST	.77
			GCT+ARI+ETST	.70
			ARI+SP+ETST	.70
Hospitalman (HM) (San Diego)	GCT+ARI	.66	GCT+ARI+ETST	.69
			GCT+ETST	.68
			ARI+ETST	.68
			ARI+2ETST	.68
Dental Technician (DT)	GCT+ARI	.51	ARI+ETST	.54
			GCT+ARI+CLER+ ETST	.54
Aviation Machinist's Mate jet (ADJ)	GCT+MECH+SP	.50	GCT+MECH+ETST MECH	.54
			GCT+MECH+SP+ ETST	.54
Aviation Structural Mechanic-Safety Equip. (AME)	GCT+MECH+SP	.51	SP+ETST	.55

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Table C - 2

Correlation of Navy Aptitude Test Batteries With Service School Performance

Service School	Present Battery	Validity Coefficient*	Improved Predictors	Validity* Coefficient
Construction Electrician (CE)	GCT+MECH+SP	.13	ARI+ETST	.53
			ARI+2ETST	.53
			ETST	.50
			ARI	.49
Signalman (SM) (San Diego)	GCT+CLER	.12	ARI	.51
			ARI+SP	.51
			GCT+ARI+SP	.51
Gunner's Mate Tech (GMT)	GCT+MECH+SP	.43	ETST	.66
			ARI+2ETST	.63
Submarine Electronic Equipment (ET)	ARI+2ETST	.46	CLER+SP	.67
			CLER+SP+ETST	.67
Steelworker (SW)	GCT+MECH+SP	.39	ARI+MECH+SP	.58
			ARI+MECH	.57
			MECH+SP	.57
Electrician's Mate (EM) (Great Lakes)	GCT+MECH+SP	.50	GCT+ETST	.65
			GCT+ARI+ETST	.65
			ARI+2ETST	.65
Signalman (SM) (Newport)	GCT+CLER	.32	ARI+SP	.47
			GCT+ARI+SP	.47
Radioman (RM) (Bainbridge)	GCT+ARI	.18	MECH+CLER+ ETST	.34
			GCT+MECH+ CLER+ETST	.31

*Validity coefficients corrected for attenuation by Spearman-Brown Formula.

Service School	Present Battery	Validity Coefficient*	Improved Predictors	Validity* Coefficient
Builder (BU)	GCT+MECH+SP	.39	ARI+MECH+CLER+ETST	.53
			ARI+CLER+SP+ETST	.53
Yeoman (YN) (San Diego)	GCT+CLER	.19	ARI	.33
			ARI+ETST	.33
			GCT+ARI+ETST	.33
Disbursing Clerk (DK)	GCT+ARI	.09	ARI	.22
			ARI+MECH	
Photographer's Mate (PH)	GCT+ARI	.60	GCT+CLER+SP+ETST	.73
			CLER+SP+ETST	.71
			GCT+MECH+CLER+ETST	.71
Aviation Support	GCT+MECH+SP	.69	GCT+ARI+SP+ETST	.81
			GCT+ARI+SP	.80
			GCT+ARI+ETST	.80
Electronics Tech A-1 (ET) (Treasure Island)	ARI+2ETST	.70	ETST	.82
			MECH+ETST	.74
Aviation Support Equipment Tech-Mechanical (ASM)	GCT+MECH+SP	.67	GCT+ARI	.79
			GCT+ARI+SP	.79
			ARI	.78
Electronics Tech A-2 (ET) (Great Lakes)	ARI+2ETST	.60	SP+ETST	.72
			MECH+ETST	.71
Communications Tech-"A" Branch (CTA)	GCT+CLER	.34	ARI	.46
			GCT+ARI+ETST	.45
Electrician's Mate (EM) (San Diego)	GCT+MECH+SP	.53	SP+ETST	.65
			ARI+SP+ETST	.65
			ARI+2ETST	.65
Personnelman (PN) (Orlando)	GCT+ARI	.41	ARI+ETST	.52
			ARI+2ETST	.52
			ETST	.51

Service School	Present Battery	Validity Coefficient*	Improved Predictors	Validity* Coefficient
Yeoman (YN) (Orlando)	GCT+CLER	.59	GCT+ARI	.70
			GCT+ARI+ETST	.70
			GCT	.69
Photographic Intelligencemen (PT)	GCT+ARI	.75	ARI+CLER+SP+ ETST	.86
			GCT+ARI+CLER+ SP+ETST	.86
Aviation Boatswain's Mate-Launching and Recovery Equip. (ABE)	GCT+MECH+SP	.41	GCT+ETST	.51
			GCT+SP+ETST	.50
Aviation Boatswain's mate-Fuels (ABF)	GCT+MECH+SP	.49	GCT+CLER+SP	.58
			CLER+SP+ETST	.57
Data Systems Tech A-1 (DS)	ARI+2ETST	.71	MECH+ETST	.80
			ARI+MECH+ETST	.79
Utilitiesman (UT)	GLT+MECH+SP	.58	GCT+ARI+CLER+ SP	.67
			GCT+ARI+CLER+ SP+ETST	.67
Machinery Repairman (MR)	GCT+MECH+SP	.56	SP+ETST	.65
			GCT+SP	.60
Aviation Boatswain's Mate-Aircraft Handling (ABH)	GCT+MECH+SP	.31	GCT+ARI+SP+ ETST	.40
			ARI	.39
			ARI+ETST	.39
			GCT+ARI+SP	.39
			GCT+ARI+ETST	.39
			ARI+SP+ETST	.39
Aviation Mechanical Fundamentals	GCT+MECH+SP	.55	GCT+ARI+ETST	.63
			GCT+ARI+MECH+ ETST	.63
			GCT+ARI+SP+ ETST	.63

Service School	Present Battery	Validity Coefficient*	Improved Predictors	Validity* Coefficient
Operations Specialist (OS)	GCT+ARI	.77	GCT+CLER+ETST	.85
			GCT+ARI+CLER+ETST	.84
			GCT+CLER+SP+ETST	.84
			GCT+ARI+CLER+SP+ETST	.84
Machinist's Mate Nuclear (MM)	GCT+MECH+SP	.47	ETST	.55
			GCT+ETST	.54
			MECH+ETST	.54
			GCT+ARI+MECH+ETST	.54
			ARI+2ETST	.54
Equipment Operator (EO)	GCT+MECH+SP	.57	ARI+MECH	.65
			ARI+MECH+ETST	.65
Air Controlman (AC)	GCT+ARI	.52	ARI+ETST	.59
			ARI+CLER+ETST	.59
			ARI+2ETST	.59
Electronics Tech Communications A-3 (ETN) (Great Lakes)	ARI+2ETST	.51	ETST	.58
			SP+ETST	.58
			MECH+SP+ETST	.58
Machinist's Mate (MM)	GCT+MECH+SP	.35	SP+ETST	.42
			MECH+SP+ETST	.40
Storekeeper (SK)	GCT+ARI	.29	ARI+CLER+ETST	.36
			ARI+CLER	.35
Torpedoman's Mate-Surface (TM)	GCT+ARI	.49	GCT+MECH+ETST	.56
			GCT	.55
			GCT+MECH	.55
			GCT+ETST	.55
Torpedoman's Mate-Submarine (TM)	GCT+ARI	.18	GCT+MECH+SP	.24
			GCT+MECH+CLER+SP	.24
Aircrew Survival Equipmentman (PR)	GCT+MECH+ SP	.52	GCT+MECH+ETST	.58
			GCT+SP+ETST	.58
			GCT+ARI+SP+ETST	.58

Service School	Present Battery	Validity Coefficient*	Improved Predictors	Validity* Coefficient
Mineman (MM)	GCT+MECH+SP	.51	ARI+MECH+CLER	.57
			ARI+MECH+CLER+ ETST	.57
			ARI+MECH+CLER+ SP+ETST	.57
Engineman (EN)	GCT+MECH+SP	.44	ARI+MECH+CLER+ SP	.50
			MECH+CLER+SP+ ETST	.49
Construction Mechanics (CM)	GCT+MECH+SP	.63	SP+ETST	.69
			ARI+SP	.67
			ARI+SP+ETST	.67
			ARI+MECH+SP+ ETST	.67
Electronics Tech (ET) A-2 (Treasure Island)	ARI+2ETST	.61	ETST	.67
			MECH+ETST	.64
			SP+ETST	.64

APPENDIX D

Validities Of ACB Aptitude Tests Used By The Marine Corps In Selection Of Enlisted Marines For Technical Service School Training

TABLE D - 1

Comparison of uncorrected validities, by course, of **I**, 2 or 3 most valid ACB subtests from regression analysis, **II**, current ACB selector composites and separate subtests (where applicable) and **III**, maximum R for all ACB subtests

(1)	(2)	(3)	(4)						(5)						(6)		(7)
Course Code	Course Name	N	2 or 3 most valid subtests, with validities, from regression analysis 1	r	2	r	3	r	Validities of current ACB selector composites and subtests 1	r	2	r	3	r	Most valid 2 subtests from (4) and (5). Subtests	Comp.	Max R using all ACB tests
0105	Sea School Indoctrination (San Diego)	194	CI	35	PA	41	ARC	44	GT	31	IN	39			CI,PA		48
0106	Sea School Indoctrination (Portsmouth)	347	GIT	34	PA	38			GT	31	IN	26			GIT,PA		40
0201	Tank Crewman	102	SM	47	MA	49	ACS	50	AE	40					SM,MA		52
0300	Basic Combat Engineer	425	AR	52	SM	60	GIT	63	AE	54					AR,SM		69
0417	Field Artillery Fire Controlman	162	PA	33	CI	41	ACS	45	GT	34	AR	32			PA,CI		48
1000	Avionics Tech.	198	ELI	28	AR	36	VE	41	EL	30	GT	33	ETST	29	ELI,AR		43
1001	Aviation Basic E&E	291	ELI	23	AR	30	PA	33	EL	22	GT	24	GM	07	ELI,AR		37
1002	Avionics Repair	91	MA	35	CI	41	ACS	43	EL	29	GT	11	ETST	26	MA,CI		46
1040	Marine Electronics	41	ELI	54	ACS	66	GIT	73	GT	43	ETST	44			ELI,ACS		82

NOTES 1. Decimal points have been deleted from correlations.
2. Underlined subtests and composites in column(6) are included in selectors in column (5).

TABLE D- 1 (continued)

Comparison of uncorrected validities, by course, of **I**, 2 or 3 most valid ACB subtests from regression analysis, **II**, current ACB selector composites and separate subtests (where applicable) and **III**, maximum R for all ACB subtests

(1)	(2)	(3)	(4)						(5)						(6)		(7)
Course Code	Course Name	N	2 or 3 most valid subtests, with validities, from regression analysis						Validities of current ACB selector composites and subtests						Most valid 2 subtests from (4) and (5).		Max R using all ACB tests
			1	r	2	r	3	r	1	r	2	r	3	r	Subtests	Comp.	
1600	Basic Electronics	675	AR	39	ELI	45	ARC	47	AR	39	GT	33	ETST	30	AR,ELI		51
1603	Teletype Repair Basic Electronics	42	AI	58	GIT	64	ARC	67	GT	36	PA	21			AI,GIT	AE	76
1604	Aviation Guaranteed	224	AR	32	ELI	36	ARC	38	GT	33	AR	32	ETST	30	AR,ELI		42
1608	Terminal Equipment Theory	96	AR	46	ELI	52	VE	53	GT	47	AR	46	ETST	38	AR,ELI		58
1609	Radio Fundamentals	214	AR	38	ELI	45	ARC	50	GT	44	AR	38	ETST	29	AR,ELI		57
1610	Telephone Switchboard	87	PA	22	AR	30	GIT	32	GT	18	GM	10			PA,AR		41
1616	Ground Radio Repair	170	MA	35	AR	40	ELI	41	GT	27	AR	29	ETST	16	MA,AR		43
1624	Air Support Operations (Operator)	49	AR	49	ACS	59	VE	63	GT	48	AR	49	ETST	24	AR,ACS		68
2020	Field Radio Operator	833	AR	37	VE	43	PA	47	GT	43	EL	29			AR,VE	GT	51
2210	Air Control/Anti-Warfare Fundamentals	42	CI	58	PA	60	ELI	73	GT	63					CI,PA		81
2220	Air Controlman	76	VE	33	AR	41	CI	44	GT	41	PA	02			VE,AR	GT	48
2430	Intelligence Assistant	56	VE	55	AR	64	SM	68	GT	64					VE,AR	GT	70

NOTES 1. Decimal points have been deleted from correlations.
2. Underlined subtests and composites in column (6) are included in selectors in column (5).

(continued)

TABLE D - 1 (continued)

Comparison of uncorrected validities [illegible] course, of I, 2 or 3 most valid ACB subtests from regression analysis, [illegible]rent ACB selector composites and separate subtests (where applicable) [illegible], maximum R for all ACB subtests

(1)	(2)	(3)	(4)						(5)						(6)		(7)
Course Code	Course Name	N	2 or 3 most valid subtests, with validities, from regression analysis						Validities of current ACB selector composites and subtests						Most valid 2 subtests from (4) and (5).		Max R using all ACB tests
			1	r	2	r	3	r	1	r	2	r	3	r	Subtests	Comp.	
4200	Aerographer's Mate	34	AR	51	VE	60	ARC	67	GT	59	CL	45	AR	51	VE,AR	GT	78
5160	Aviation Maintenance Administration	117	AR	52	VE	59	PA	61	GT	59					VE,AR	GT	66
5170	Marine Aviation Operations Clerical	149	VE	65	ACS	74	AR	78	GT	74					VE,ACS	CL	81
5200	Basic Administration Clerk	493	VE	29	ACS	34	AR	35	GT	33	CL	34			VE,ACS	CL	37
5201	Basic Clerical	591	AR	51	ACS	59	VE	63	GT	57	CL	59			VE,AR, ACS	CL GT	65
5328	Systems 360 Operating Systems Technician (operations)	116	AR	31	VE	37	CI	40	GT	37	PA	17	EDPT	36	AR,VE	GT	43
5420	Personnel Financial Records	180	AR	42	ACS	49	PA	51	GT	37	CL	36			AR,ACS		54
5510	Marine Aviation Supply	319	AR	51	ACS	57	VE	60	GT	55					AR,ACS		62
5514	Marine Enlisted Basic Amphibious Embarkation	36	PA	55	VE	59	ARC	62	GT	40	CL	25	AR	28	PA,VE		72
5800	Communications Centerman	375	VE	30	ACS	36	AR	38	GT	35	CL	35			VE,ACS	CL	40

NOTES 1. Decimal points have been deleted from correlations.
2. Underlined subtests and composites in column (6) are included in selectors in column (5).

(continued)

TABLE D - 1 (continued)

Comparison of uncorrected validities, by course, of I, 2 or 3 most valid ACB subtests from regression analysis, II, current ACB selector composites and separate subtests (where applicable) and III, maximum R for all ACB subtests

(1)	(2)	(3)	(4)						(5)						(6)		(7)
Course Code	Course Name	N	2 or 3 most valid subtests, with validities, from regression analysis 1	r	2	r	3	r	Validities of current ACB selector composites and subtests 1	r	2	r	3	r	Most valid 2 subtests from (4) and (5). Subtests	Comp.	Max R using all ACB tests
6000	Aviation Familiarization	1852	AR	39	PA	45									AR,PA		46
6001	Aviation Support Equipment Technician (Electrical)	51	VE	41	MA	49	CI	54	GT	43	ETST	51			ETST,MA		67
6003	Aviation Support Equipment Technician (Hydraulic)	43	ELI	45	VE	48	GIT	51	GT	34	ETST	38			ELI,VE		63
6005	Basic Helicopter	232	AI	39	VE	47	PA	50	GT	37	GM	36			AI,VE		53
6010	Aviation Machinist's Mate (Jet)	282	GIT	35	VE	41	PA	42	GT	36	GM	35			GIT,VE		47
6011	Aviation Machinist's Mate (Reciprocating)	39	MA	59	AR	68	ELI	71	GT	32	GM	37			MA,AR		78
6020	Aviation Electrician's Mate	99	ACS	34	PA	42	GIT	47	GT	25	GM	25	ETST	47	ETST,ACS		56
6022	Aviation Structural Mechanic (Hydraulic)	83	SM	37	GIT	44	PA	50	GT	32	GM	43			SM,GIT		61
6023	Aviation Structural Mechanic Structures	119	SM	40	AR	51	PA	55	GT	38	GM	47			SM,AR		57

NOTES 1. Decimal points have been deleted from correlations.
2. Underlined subtests and composites in column (6) are included in selectors in column (5).

(continued)

TABLE D - 1 (continued)

Comparison of uncorrected validities, by course, of I, 2 or 3 most valid ACB subtests from regression analysis, II, current ACB selector composites and separate subtests (where applicable) and III, maximum R for all ACB subtests

(1)	(2)	(3)	(4)						(5)						(6)		(7)
Course Code	Course Name	N	2 or 3 most valid subtests, with validities, from regression analysis						Validities of current ACB selector composites and subtests						Most valid 2 subtests from (4) and (5)		Max R using all ACB tests
			1	r	2	r	3	r	1	r	2	r	3	r	Subtests	Comp.	
6100	Basic Automotive Mechanic	673	GIT	47	AR	54	AI	58	MM	47					GIT,AR		60
6110	Tracked Vehicle Repair (AMTRAC)	88	AI	39	GIT	46	MA	48	MM	44					AI,GIT	AE	54
6111	Tracked Vehicle Repair (SPARTY)	46	ELI	52	MA	62	AR	65	MM	56					ELI,MA	EL	71
6112	Tracked Vehicle Repair (TANK)	76	AR	34	AI	41	PA	45	MM	29					AR,AI		53
6120	Engineer Equipment Mechanic	141	AI	52	AR	60	ARC	61	MM	54					AI,AR		63
6410	Small Arms Repair	196	AR	47	ELI	54	MA	57	GM	47					AR,ELI		61
6420	Artillery Repair	47	AI	51	CI	63	MA	66	GM	59					AI,CI		73
6450	Ammunition Storage	179	VE	39	AI	43	AR	46	GT	41	GM	25			VE,AI		47
6460	Aviation Ordnanceman	69	GIT	18	ACS	23	ARC	25	GT	12	GM	17			GIT,ACS		30
6300	Aircraft Launch and Recovery Equipment	67	VE	56	AI	62	AR	67	GM	56					VE,AI		73
7000	Basic Metal Worker	62	ACS	35	AI	41	CI	45	GM	28					ACS,AI		52

NOTES 1. Decimal points have been deleted from correlations.
2. Underlined subtests and composites in column (6) are included in selectors in column (5).

(continued)

TABLE D - 1 (continued)

Comparison of uncorrected validities, by course, of **I**, 2 or 3 most valid ACB subtests from regression analysis, **II**, current ACB selector composites and separate subtests (where applicable) and **III**, maximum R for all ACB subtests

(1)	(2)	(3)	(4)						(5)						(6)		(7)
Course Code	Course Name	N	2 or 3 most valid subtests, with validities, from regression analysis						Validities of current ACB selector composites and subtests						Most valid 2 subtests from (4) and (5).		Max R using all ACB tests
			1	r	2	r	3	r	1	r	2	r	3	r	Subtests	Comp.	
7200	Basic Plumbing and Water Supply	48	ELI	27	ARC	36	SM	42	GM	20					ELI,ARC		52
7211	Basic Electrician	109	CI	31	ARC	33	MA	35	EL	02					CI,ARC		39
7300	Engineer Equipment Operator	177	AI	37	CI	46	GIT	49	GT	20	MM	39			AI,CI		52
7800	Aviation Crash Crewman	134	GIT	36	ACS	45	ARC	48	AE	33	GM	37			GIT,ACS		53
8001	Basic Food Services	191	GIT	46	AR	55	CI	59	GT	52					GIT,AR		65
8310	Law Enforcement (Correctional Specialist)	569	VE	36	AR	41	GIT	44	GT	41					VE,AR	GT	45

NOTES 1. Decimal points have been deleted from correlations.
2. Underlined subtests and composites in column (6) are included in selectors in column (5).

TABLE D - 2

Uncorrected validities of current selectors and proposed selectors for 8 courses in which revised selectors should be considered

Course Code	Course Name	N	Current Selectors	r	Proposed Selectors	r	Diff.	p
0105	Sea School Indoctrination, San Diego	194	GT + IN	.40	GT + IN + GIT	.40	.00	N.S.
0106	Sea School Indoctrination, Portsmouth	353	GT + IN	.31	GT + IN + GIT	.36	.05	.05
0201	Tank Crew	102	AE	.40	AE + SM	.48	.08	.05
1001	Aviation Basic E&E	291	EL + GT + GM	.26	GT + ELI + PA	.36	.10	.01
2020	Field Radio Operator	833	EL + GT	.43	EL + GT + PA	.46	.03	.05
2220	Air Controlman	76	GT + PA	.24	GT	.41	.17	.01
5420	Personnel Financial Records	180	GT + CL	.41	AR + ACS	.48	.07	.05
7300	Engineering Equipment	177	GT + MM	.37	MM + VE + CI	.44	.07	.05

APPENDIX E

Major Divisions And Subdivisions Of
McCormick's Position Analysis Questionnaire

Figure E - 1

Major Divisions and Subdivisions of the PAQ
With the Number of Job Elements In Each Subdivision.
Following Each Subdividion Is the Title of
An Illustrative Job Element.

INFORMATION INPUT (35)
- Sources of job information (20): Use of written materials.
- Discrimination and perceptual activities (15): Estimating speed of moving objects.

MEDIATION PROCESS (14)
- Decision making and reasoning (2): Reasoning in problem solving.
- Information processing (6): Encoding/decoding.
- Use of stored information (6): Using mathematics.

WORK OUTPUT (50)
- Use of physical devices (29): Use of keyboard devices.
- Integrative manual activities (8): Handling objects/materials.
- General body activities (7): Climbing.
- Manipulation/coordination activities (6): Hand - arm manipulation.

INTERPERSONAL ACTIVITIES (36)
- Communications (10): Instructing.
- Interpersonal relationships (3): Serving/catering.
- Personal contact (15): Personal contact with public customers.
- Supervision and coordination (8): Level of supervision received.

WORK SITUATION AND JOB CONTEXT (18)
- Physical working conditions (12): Low temperature.
- Psychological and sociological aspects (6): Civic obligations.

MISCELLANEOUS ASPECTS (36)
- Work schedule, method of pay, and apparel (21): Irregular hours.
- Job demands (12): Specified (controlled) work pace.
- Responsibility (3): Responsibility for safety of others.

APPENDIX F

Instructions For Using Hanman's Specific Method

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APPENDIX F

This Appendix is based upon the Manual that is a part of Hanman's book[50] with adaptations made for purposes of this technical report. It is designed to aid task analysts in OMU, physicians, and others who may use the Specific Method, in understanding and applying the method. It includes definitions of terms and details of the forms that are used. The presentation of information about the Specific Method in considerable detail is intentional. It is provided in this form in order to aid in the training of task analysts and others who may use the method.

The Appendix is organized into parts: I. Instructions For Using The Specific Method; II. Supplementary Instructions for Training Task Analysts in the Use of The Specific Method and, III. Definitions Of Physical And Environmental Factors.

I. INSTRUCTIONS FOR USING THE SPECIFIC METHOD

Task analysts should familiarize themselves with Form 1, "Physical Demands Analysis Work Sheet" included at the end of Section III, methods of recording data (Sections I and II), and with the definitions for the forty-nine physical and thirty-one environmental factors in Section III of this Appendix. Physicians and any other medical personnel who make judgments about the physical capacities of Marines must also become familiar with the definitions and instructions for recording their judgments in order to complete Form 3 in a consistent manner. This section and Section III are important reading for medical personnel who use The Specific Method.

The Work Sheet is used by task analysts in recording the physical and environmental demands of jobs. The eighty factors cover practically all possible demands of a physical nature that would be encountered in any work situation. It is suitable for the entire range of tasks requiring physical effort and exposure to different environmental conditions. Examination of the Work Sheet makes it apparent that the Specific Method is not designed for "white collar" positions that do not require significant physical effort.

The Work Sheet was developed and tested over a period of seven years in the analysis of over 5,000 jobs. Reliability estimates of the analysts' work indicated that the average error made by an analyst was 3.7 percent when all differences in their judgment were taken into account.

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[50] Ibid. By permission of John de Graff, Inc., New York.

A. Recording Job Demands in Terms of Time Required.

There are spaces or boxes on the Work Sheet for each of the eighty factors. For each factor required by the job, the analyst fills in the box with a number indicating the maximum time, in hours and/or minutes, that the factor is required during a normal work day. For example, if a total of four hours of walking is required, a "4" is entered in the box adjacent to item 26, "walking". When a factor is required for less than one hour, fractions of an hour are recorded as either 1/4, 1/2 or 3/4 of an hour. It is not practical to use smaller fractions even though the factor may be required for only 10 minutes or 40 minutes, for example, because physicians who judge individuals' capacities cannot, or should not try to be more accurate than this. The analyst could perhaps be more accurate, but it serves no practical purpose to do so.

It is important that the analyst determine and record the maximum number of hours a factor may be required, even though the maximum demands may be required only rarely. Some factors may never be required. To indicate that a factor has been considered and found not to be required, the analyst places a dash (-) in the box.

B. Sensory Factors

The Sensory factors require special attention. Factors 42, far vision, and 43, near vision, are filled in by using special notations, such as 20/20, 20/15, etc. These are discussed in the definitions of factors in part III. Other sensory factors, 44-47, are marked with a plus sign (+) if they are found to be required, rather than by number of hours. This is done because the time element is not considered applicable. For example, it may be very important that a person possess full color vision, but whether the person must be able to recognize color for several hours or only 15 minutes a day is of little consequence.

C. Environmental Factors

Additional information is required for several environmental factors. Maximum and minimum temperatures are entered in the space provided next to items 53 and 54, in addition to the hours at each temperature. If exposure to radiant energy is required (item 67) the nature as well as the time is indicated. Similarly, the type of toxic conditions (item 70), if present, is recorded. Item 78, shifts, requires designating the length of the shift in hours, and a symbol indicating which shift, 1, 2 or 3; or, D for day shift, S for swing shift, and G for graveyard may be used.

D. Meaning and Use of R, L, and E

The factors of fingering, handling, reaching and throwing usually require use of hands either singly or in combination: right hand,

left hand, either hand, or both hands. Similar combinations occur when feet are used on a job requiring treading, and rules for recording data are the same for both hands and feet. However, for simplicity in this discussion, reference is made only to use of the hands. Information is reported in the following manner on Forms 1 & 2, Items 13-22 and 31-34:

1. If the right hand is needed and the left is not, the total time it is needed in hours is entered in the box marked R, for the factor under consideration, and the box marked L is left blank. Each of the hand-related factors have two boxes, marked R and L.

2. If either the right or left hand is required, a letter "E" and the number of hours the hand (either hand) is required is entered, as before, in the box marked R.

3. If both hands are required, the time each is required is entered in the appropriate boxes, R and L.

4. If the right hand is required for some operations, and either hand is required for others, two numbers, separated by a comma are entered in the "R box". The first number should represent the time the right hand only is required; the second should represent the time either hand is required, and should be identified with the letter "E".

Table 1 illustrates these and various other possible combinations of requirements. There are reasons for not including a separate box for "either". A job with a factor where either hand may be used can be filled by a person who can use only his right or left hand. Trying to match "either" boxes in the classification and assignment process would therefore be confusing. This problem is eliminated by using only two boxes, R and L, and by designating tasks which can be performed with either hand with a letter "E" in the R box. Placing the E in the L box would accomplish the purpose equally well, but only the R box is designated for this use, for consistency. This system may appear to be arbitrary, but experimentation with several formats showed it to be the easiest and most practical solution.

E. Meaning of time Requirements.

As mentioned earlier, the analyst must record the maximum total time for a factor that is definitely required during any one work day, however infrequently those maximum factor days may occur. It is not the frequency of occurrence but how definite is the occurrence which determines the limit of physical capacity. The following cases may be helpful in illustrating this principle under various conditions.

1. Fluctuating demands. Extensive fluctuations are often found with lifting, carrying, and certain other factors. As an extreme

Only Right Required		Only Left Required		Both Right and Left Required		Either Right or Left Required		Only Right plus Either Required		Only Right plus Either Required		Right and Left plus Either Required	
2	R		R	2	R	3E	R	2,3E	R	3E	R	2,3E	R
	L	2	L	2	L		L		L	2	L	2	L

Examples of Recording Right (R), Left (L), and Either (E) Requirements for Fingering, Handling, Reaching, Throwing, and Treading

TABLE F - 1

example, a job may require standing eight hours one day, sitting eight hours another day, and walking eight hours on a third type of day. If so, each of these three factors should be marked "8", as being required for eight hours. Theoretically, a single job could require all factors on the Work Sheet for eight hours, or whatever hours in a shift.

2. Optional demands. Analysts should take care not to be misled by behaviors performed by the Marine that are optional, but not required. The most frequent error of this type is reporting a requirement of either standing or sitting, when in fact, the job incumbent may either stand or sit as he chooses. A person may sit for most of the day because it is easier. However, unless the job actually requires standing or sitting, the analyst should leave boxes for both standing and sitting blank. To do otherwise would unnecessarily prevent some people from filling the job--people who could perform the job either without standing or without sitting, as they wished.

3. Stable job. For jobs with routine, stable demands, the sum of the time on the feet, off the feet, and waiting time should equal the length of the shift, normally eight hours. Analysts should check their work by summing these factors. Similarly, the sum of the times required by the separate factors which involve being on the feet, e.g. standing, walking, climbing, jumping, and running, should equal the Total Time on Feet, factor 24. "Waiting time" refers to those periods when the person is not required to be active. In most jobs, the person must wait occasionally for certain things to be completed before he can proceed with his tasks. During these periods the person is usually free to sit, stand, walk or do what he wants. This time should not be included under Total Time on Feet or any factor other than Waiting Time, factor 41, because of the optional nature of action during this time.

F. Intensity Requirements.

In developing the Work Sheet, certain trade-off's and exceptions were made in the effort to accomodate criteria of practicality and simplicity on the one hand and represent real-world complexity on the other. It was determined that for most of the eighty factors, the dimension of time requirements for an activity is not only sufficient, but preferable to attempts to record the nature of physical demands in terms of additional dimensions. For example, the walking factor could be recorded in terms of the total distance walked as well as time; distance would supposedly indicate "intensity". Hanman's work indicates that further assessment of intensity beyond the itme requirement does not yield sufficient benefits to justify the costs of these extra measures. The analyst, Hanman argues, needs only to record the time requirements to show both time and intensity.

There are, however, three exceptions: lifting, carrying and temperature. For lifting and carrying it is considered useful to

specify the intensity in terms of pounds as well as time. For this reason, the lifting and carrying factors are each broken down into six "factors", which represent the range of pounds to be lifted or carried. For example, if the person must carry a 28 lb. weapon for 6 hours, this is indicated by placing a "6" in the box by item 10, the category for carrying 26-50 lbs. Similarly, the job may require exposure to hot or cold temperatures, items 53 and 54, defined as temperatures extreme enough to cause bodily discomfort. The typical extreme temperature should be written on the dotted line provided, and the number of hours of exposure to this temperature required in a day is placed in the box.

G. Frequency Requirements.

Frequency refers to the rate at which a physical demand is required, for example 10 times per day, twice daily, or once per hour. The Work Sheet is not designed to show frequency data, for several reasons. First, frequency rates for physical demand activities usually fluctuate widely, making it almost impossible to record them accurately.

Second, detailed data on frequency were found to have little value in placement. Measurement of frequency rates for activities may be important for studies of motivation or other special purposes, but its value for classification and assignment has not appeared to be very important. Frequency rates for activities should not be confused with skills. If performance of an activity is required at a faster rate than most Marines can perform, the activity should be treated as a skill requirement, not a physical capacity demand. Third, in the related process of determining an individual's capacities, it would be unjustifiably complex and expensive to ascertain the abilities of individuals with regard to frequency rates for numerous job demands.

Hanman points out that most work activities are intermittent in nature. For the purpose of task analysis, the analyst should report only the total time in which the physical demand is imposed. For example, if the job requires lifting a 50 lb. container only for a few seconds, once per month, a "1/4" is entered in the box for item 4, which designates lifting, in the 26-50 lb. category. It will be remembered that 1/4 is the smallest unit of time reported in the Specific Method.

H. Special Situations.

The task analyst may encounter some jobs in which the manner of the job is performed varies from the standard job description . Under such circumstances the analyst will need to make modifications in this application of the Specific Method. Two general categories that require the analyst to make adaptations to special situations are cited as examples.

1. Job Interchangeability.

Sometimes, Marines are placed in jobs other than their primary job, either temporarily or under special circumstances, e.g. combat conditions. These conditions may represent frequent or infrequent variations from standard job performance in a Marine's MOS.

a. Frequent Change. When a Marine is frequently asked to perform tasks beyond his assigned job (MOS), it is suggested that the demands of these frequent tasks or duties be included in the analysis. One Work Sheet should be prepared reporting the composite demands of the interchangeable jobs and the tasks that are not listed in the Marine's primary MOS. Titles for all of these jobs and tasks should be recorded on the Work Sheet under the primary job title for the MOS.

b. Infrequent Change. Where Marines are more or less permanently assigned to one job, it is suggested that a separate Work Sheet be prepared for this job, and another for jobs which are infrequently interchangeable with that job. On the Work Sheet, after the job title it should be written, "Infrequently interchangeable with jobs numbered ....." (enter appropriate job numbers).

Evaluation of the frequency of job interchangeability is dependent upon the judgment of the analyst. Rather than attempt to state a general guideline here, it is suggested that the analyst first determine criteria specific to the situation: opportunities for flexibillty and judgment in the job interchange process, relative importance of each job, long term benefits to manpower utilization, etc. Consultation and discussion with other analysts and persons familiar with the job should be helpful in weighing these criteria and arriving at a decision.

2. Unlisted Physical or Environmental Job Demands.

Occasionally is is necessary for the analyst (or physician) to write in an additional job factor under "other". Items 48 and 49 under Physical Demands and items 79 and 80 under Environmental Demands are left blank for this purpose. In Part III of this Appendix, Definitions of Job Factors, various types of factors which have been added in this manner are listed and defined. These include, smelling, tasting, balancing, feeling, blowing, dry hands, and working speed, among the physical demands. Examples of "other" envirommental factors are air pressure, underground, odors, drafts, and sea travel.

II. SUPPLEMENTARY INSTRUCTIONS FOR TRAINING TASK ANALYSTS IN USE OF THE SPECIFIC METHOD

In training analysts, it is important to recognize the differences between the process of analyzing physical and environmental demands of a job and the more general task analysis process. The type of judgments required in the Specific Method are both different and more difficult in several ways. In the Marine Corps, the task analyst typically determines only if an activity occurs. The physical demands analyst must determine if some eighty specific physical and environmental factors are inherently required in the activity.

By administering a Task Analysis Inventory, the Marine Task analyst determines the frequency of a job activity from responses to the Inventory on a 7 point scale from "never" to "always". On the other hand, in the analysis of physical demands the task analyst must rely on his own judgment in specifying the time, in hours, for which a physical demand is required. This type of judgment is more precise and verifiable, and often requires an understanding of alternative methods of performing the task. Its implications are clear and testable. These specific discriminations are sometimes difficult to make. However, the extra effort and judgment required is necessary in order to appraise their value and usefulness for classification and assignment. The Specific Method will allow the Marine Corps to recruit, classify, assign, and better utilize persons who, in past practice, may have been rejected or limited because of assumed physical demands. The assessment of physical demands permits greater utilization of personnel while preventing unsafe classification and assignment.

In the following paragraphs, suggestions are offered as additional aids in training task analysts in evaluating physical and environmental demands.

A. Record Requirements Only.

Distinguishing between those activities which job holders are observed to perform and those activities actually required by the job is considered the most difficult task to be learned by the task analyst in applying the Specific Method. The acquisition of skills in making these discriminations is essential for a Marine to become an effective analyst. The difficulty arises when Marines engage in behaviors not actually required by the job itself, or perform extraneous activities when they know they are being observed.

Some Marines may wish to make their job seem more demanding and complex than it is. Illustrations from Hanman's studies include a man who jumped from a platform rather than using the nearby steps. Of course jumping was not reported as a job requirement. An arc welder used his hearing to maintain the proper arc, by listening to the

hissing sound. Yet deaf people work well as welders. Seeing, not hearing, is required in maintaining the proper arc. A Marine may stand at a workbench rather than use available, unseen stools. Neither standing nor sitting should be reported as being required when the job holder has the option of doing either. A person may repair his own equipment either by choice or by necessity. The analyst may have to determine which.

Special assignments may also be a cause of some confusion. The analyst must insure that activities which are part of a special assignment are not considered as part of the job. Separate discussions with different job holders and with their immediate supervisor may reveal some differing perceptions of job activities, job requirements, and special activities.

B. Record Only What is Required, Not How and Why it is Required.

It may be frustrating at first for task analysts to use a Work Sheet which does not allow them to explain what a Marine is doing that requires a physical or environmental factor. There is no space for reporting how the Marine does it or why he does it. This information is unnecessary for classification and assignment based upon physical and environmental factors. Analysts may wish to include a written description of the physical demands along with the Work Sheet. This extra reporting would be time-consuming, lead to problems in interpretation, and above *all, is not necessary for* the mechanical or computerized process of screening individuals in relation to physical demands.

C. Analyze the Present Job.

Most job analysts are aware of the importance of analyzing job demands exactly as they exist at the time of the analysis. Although jobs change from time to time, the analyst should not be influenced by factors which have existed in the past, may exist in the future, or that exist in other units.

Neither should the analyst attempt to report the job as he believes it should exist. If suggestions for changes are detected, the analyst may make separate notes of these possibilities. Then, if the job is changed, it should be re-analyzed in terms of any new demands. Again, the analyst observer must insure that he does not report the job demands as the job holders or their superiors may want them to be reported. He should only record and report the facts as he finds them.

D. Identify the Job.

In some cases it may be difficult to identify the boundaries of the job to be analyzed. It is not unusual for people who are working

in the same area or on the same task to help each other, overlap functions and activities, or allow others to handle some things for them. In analyzing jobs under these conditions, it is useful to have a common understanding of concepts and guidelines for determining job boundaries. Hanman offers this breakdown:

- A TASK is a responsibility requiring the expenditure of human effort.

- A POSITION is made up of a group of tasks requiring the full-time services of one person.

- A JOB refers to the group of positions which are basicly the same in the major tasks performed.

E. Observe and Verify Information.

Because the analyst may not be able to observe all activities required by the job, he may have to rely on discussions with the immediate supervisor for information about the job being analyzed. It is usually considered preferable not to interfere with people who are in the process of performing their job, or to rely solely on their views. Experienced analysts suggest that taking notes while observing a person perform his tasks may influence or distract him; it is preferable to move to an office or another place for note taking, immediately ofter observing the job.

Three aspects of job activities that usually require discussion and verification with the immediate superior of Marines whose jobs are being analyzed are unobserved job activities, location variations and shift variations. These three areas are discussed below.

F. Cover the Range of Required Activities.

The analyst may not be able to observe the complete range of activities required by a job, especially the functions which occur infrequently. Nevertheless he should record the demands of the total job. Again, this requires obtaining information from supervisors and others available who possess the required information.

G. Location Variations.

It is sometimes necessary to prepare more than one Work Sheet for one job. This is rarely necessary for job analysis, because skills and job activities generally tend to be much the same regardless of location. In physical demands analysis, however, it is not unusual for environmental and even physical demands to vary significantly from location to location. Noise, heat, cold, wet quarters, humidity and waiting time are examples of varying factors. These variations may be geographical, regional, local, or related to the equipment used,

the type of buildings or the surrounding terrain.

H. Shift Variations.

If there are different shifts or watches, and no requirement that everyone rotate through all shifts, the analyst should evaluate each shift separately. If the demands are identical, only one Work Sheet need be prepared. However, significant differences in demands may be found among shifts. If they do occur, separate Work Sheets for each shift should be prepared and labeled appropriately.

I. Other Variations.

For some jobs, there will be wide variations in real or semi-optional demands, for example, the ease of getting to and from supply depots, and the availability of certain supplies or conveniences such as air conditioning, space, and various services. Rather than include any demands related to these variations, it is recommended that the analyst prepare a separate written statement describing these variations, and submit it as an attachment to the Work Sheet. It is generally more practical to handle any necessary adjustments related to these factors at the local level.

J. Other Suggestions for Analyst Training.

Hanman reports that physical demands analysts were able to perform their task better and faster when they became specialized on the basis of occupational category. For example, one analyst might specialize in aviation OF's, and another in electronics,electrical and communications OF's.

When learning to use the Specific Method, it is suggested that analyst observers will benefit from working in pairs, and comparing and reviewing their ratings with each other. No less than once a week, the trainee analysts should meet together to review and discuss their findings. The training sessions themselves might employ a variety of teaching techniques. Here the experience and creativity of the trainer will come in to play. In one procedure that has proven effective, the instructor has each of the trainees analyze a simple job independently, then bring their reports together for comparison and discussion. Various types of jobs, progressively more complex, are analyzed and studied in this way until the trainees acquire sufficient practice and knowledge to meet training criteria.

III DEFINITIONS OF THE PHYSICAL AND ENVIRONMENTAL FACTORS

The following definitions were developed and tested by Hanman over a period of several years in industrial plants in the United States and Europe. They have proven effective in practical application, but they should not be considered perfect or unadaptable. The value of a manual of definitions is that every analyst shares the same definitions. The definitions may be redefined or clarified should changing needs make this desirable.

A. PHYSICAL FACTORS

1. Lifting. (Factor numbers 1-6 on Forms 1, 2, and 3) Raising or lowering an object from one level to another by using muscular strength, usually by grasping the object with the hand or hands.

2. Carrying. (7-12) Transporting an object by using muscular strength, usually by holding it in the hand(s) and arm(s).

In determining the time element for Lifting and Carrying, the time an object is carried should be included in the time the object is lifted since one must also lift while carrying. Carrying time, therefore, should never exceed lifting time. As an example for the analyst: if a worker is required to stand at a bench and lift 25 pound objects for 2 hours, and also is required to carry the 25 pound objects away from the bench for 1 hour, then it should be recorded that the job requires lifting 25 pounds for 3 hours and carrying 25 pounds for 1 hour.

Remembering that one must also lift while carrying, the physician, too, should not allow a limited worker more carrying than lifting ability. As a general rule for workers with limited capacities, the physician often allows the man to carry half the time he is allowed to lift. For example, if the worker is restricted to lifting 25 pounds intermittently for 1 hour during the work period, then he may be allowed to carry 25 pounds intermittently for 1/2 hour. This general rule, however, is but a guide and does not apply to all restricted workers since some can lift but not carry due to walking difficulties. The idea behind this general rule is that carrying is approximately twice as difficult as lifting alone and therefore the limited worker should not carry more than half the time he is allowed to lift.

The factors of Lifting and Carrying as shown on Forms 1, 2, and 3 are broken down into 12 subfactors representing different weights. On these Forms, the different weights are shown in pounds. The following table shows the corresponding scale used when weights are expressed in kilos.

Breakdown for Lifting and Carrying

In Kilos	In Pounds
0.5--2	1--5
3--5	6--10
6--10	11--25
11--25	26--50
26--50	50--100
50+	100+

A. PHYSICAL FACTORS (cont.)

3. Pushing. (1--12) Exerting muscular force upon an object so that the force is directed away from the person, including slapping and striking.

4. Pulling. (1--12) Exerting muscular force upon an object so that the force is directed toward the person, including jerking.

The Factors of Pushing and Pulling are most complex. Although it is possible for the analyst to measure the pushing or pulling force exerted by setting up scales for this purpose, the results are most misleading due to the numerous body positions from which these activities may be required. For example, one worker may be required to reach above his head and pull wires through a conduit, and pulling with all his strength, may exert a force of around 20 pounds when recorded on a scale. Another worker may be required to pull wires through a conduit at waist height, and, with one foot braced against the wall, may exert a force of around 200 pounds with very little effort. Both job and laboratory studies of these factors have revealed that certain body positions require more effort to push or pull 5 pounds than other positions require to push or pull 300 pounds. Also, there are possibilities of several hundred body positions from which these activities may be required to be performed. It is evident, therefore, that recording the actual force exerted in pushing and pulling may lead to serious misunderstandings. It may be thought that pushing or pulling with a 200-pound force requires great effort, while, depending upon the body position, the exact opposite may be true.

Because of this complication, it is better that the analyst convert the pushing or pulling force required into its equivalent of lifting so many pounds, that is, when pushing or pulling are required from stationary positions such as Sitting, Standing, Stooping, and Reclining. When, however, pushing and pulling are required while moving, as in pushing a hand truck, then the force exerted should be converted into its equivalent of carrying so many pounds (remembering that carrying also includes lifting).

Unfortunately, research is incomplete and there is no conversion table to assist the analyst in calculating the lifting and carrying equivalents of pushing and pulling efforts. Even so, the analyst's guess as to the lifting or carrying equivalent is better than showing the actual force exerted in pushing and pulling when registered on a scale.

As an example of estimating pushing and pulling effort in terms of lifting and carrying equivalents, a truck driver, when turning the wheels of a parked truck, may pull on the steering wheel with a force of around 100 pounds if registered on a scale. This pulling effort, however, would probably not be greater than lifting 25 pounds. The analyst, then, would record the length of time this effort is required and indicate it under Lifting 25 pounds.

A. PHYSICAL FACTORS (Cont.)

4. Pulling. (Cont.)

From the physician's point of view, the problem is simplified by having Pushing and Pulling included in Lifting and Carrying. By recording the maximum number of hours a worker may lift and carry a maximum number of pounds it then becomes understood automatically that the worker should not exert greater effort in pushing and pulling than that exerted in lifting and carrying the maximum load allowed him. For the physician, then, pushing and pulling should present no problems.

5. Fingering. (13--14) Picking, Pinching, or otherwise working with dexterous movements of the fingers of either or both hands. Not to be confused with Handling.

6. Handling. (15--16) Seizing, holding, grasping, turning, or otherwise working with the hands of either or both arms. Not to be confused with the dexterous movements of Fingering.

7. Reaching. (17--20) Extending the hands and arms in any direction, reaching above or below shoulder height with either or both arms.

8. Throwing. (21--22) Propelling an object through space by a swinging motion of either or both hands and arms either with or without the use of tongs or other devices.

9. Sitting. (23) Resting upon the haunches as in occupying a bench, chair, or saddle. Squatting, sitting on the heels, or sitting on the ground, should be considered as Crouching, not as Sitting.

10. Total time on feet. (24) This period is the maximum number of hours the job requires the worker to be on his feet during the work shift. For the usual routine job, Total Time on Feet should equal the sum of the time required by the separate factors of Standing, Walking, Climbing, Jumping, and Running.

11. Standing. (25) Supporting oneself on either or both feet and legs in an upright or nearly upright position.

12. Walking. (26) Moving about on the feet by taking alternate steps, usually on a horizontal plane, setting one foot before the other without running.

13. Running. (27) Moving rapidly by using the feet and legs more quickly than in walking, usually on a horizontal plane.

14. Jumping. (28) Projecting the body up, down, or horizontally through the air, primarily by a muscular action of the feet and legs.

15. Climbing--legs only. (29) Ascending or descending such fixtures or places as ramps, stairs, and hills by using the legs and feet only.

A. PHYSICAL FACTORS (Cont.)

16. Climbing--legs and arms. (30) Ascending or descending such fixtures as ladders, scaffolding, poles, and ropes by using the hands and arms in addition to the feet and legs.

17. Treading. (31--34) Exerting force upon an object with either or both feet and legs. This activity may be required while sitting, as in operating the pedals of an automobile, or while standing, as in operating a clothes press.

18. Stooping. (35) Bending the body downward from a standing position by bending the legs in addition to bending the spine, including the acts of remaining in these positions. Not to be confused with Crouching.

19. Crouching. (36) Bending the body downward from a standing position by bending the legs in addition to bending the spine, including squatting, sitting on the heels, and sitting on the ground; also including the acts of remaining in these positions. Not to be confused with Stooping.

Stooping and Crouching from the stationary position of Standing should not be considered as distinct from Standing. The time the worker is required to Stoop or Crouch should be included in the time the worker is required to Stand. Should the worker Stoop or Crouch while Walking or Running, the time should be included in the time for Walking or Running.

20. Kneeling. (37) Bending the legs at the knees to come to rest on the knee or knees, including the act of remaining on the knee or knees.

21. Crawling. (38) Moving about on the hands and knees or hands and feet.

22. Reclining. (39) Assuming a horizonal working position on the back, belly, or side.

23. Twisting. (40) Turning the body partly around from stationary positions such as Standing, Sitting, Kneeling, and Reclining, involving a tension on the body muscles and spine, and including the acts of remaining in these positions. Stooping backward should be considered as Twisting, not as Stooping.

24. Waiting Time. (41) Inaction due to the intermittent nature of the job, as in the case of a tack welder who is required to be inactive while waiting for other workers to prepare the materials to be welded.

A. PHYSICAL FACTORS (Cont.)

24. Waiting Time. (Cont.)

Should a job require the worker to have periods of inaction totaling 2 hours a day, the analyst should show this 2 hours under Waiting Time and not under Sitting, Standing, or Walking even though the worker may sit, stand or walk during these 2 hours. Periods of inaction should be treated in this manner due to the usually optional nature of body positions and activities during such periods.

25. Seeing. (42--45) Perceiving the nature of objects by sight. Although it is not difficult for physicians to determine the visual acuity of workers, there is no easy or even accurate method for determining the visual requirements of jobs. The visual analysis of jobs presents a complex problem. Even after long and extensive study on the part of optical research laboratories, present techniques are still developmental. They do more to define the problems involved than to answer them. Nevertheless, plants with problems in industrial vision might benefit by investigating some of the advanced techniques now available through the larger optical companies. Industrial vision is a professional field of its own and requires the services of industrial ophthalmologists.

Only in a coarse fashion can the job analyst do visual analysis work. When a plant is lacking the professional services of industrial ophthalmologists, the job analyst can be of help with far and near visual requirements in the following ways:

26. Far Vision. (42) The analyst can determine the size of the most difficult object the job requires the worker to see at a distance of 5 feet or more, and also the distance the object is from the worker. Once this is done, the analyst can refer to the Visual Acuity Tables shown on the following page--Snellen (inches), Monoyer, or Snellen (metric), depending on which system is used--and there locate the proper notation for the far vision requirements of the job.

For example, when using the Snellen Visual Acuity Table (inches), suppose that a worker is required to see finger signals at a distance of 100 feet, and the average fingers are about 3 inches long. Then, by referring to the Snellen Table, the Analyst finds 3 inches in the first column, follows across the page to the 100-foot column, and there finds the figure 30. This means that the worker needs 20/30 vision to see finger signals at 100 feet. The figure 20 is always to be placed in front of the number the analyst locates in the Snellen Table, such as 20/20, 20/30, 20/40, and so on.

Although all three of the Tables on Page **120** are mathematically correct, they are not technically accurate from the ophthalmologist's point of view because of objections to the Snellen and Monoyer methods

A. PHYSICAL FACTORS (Cont.)

26. Far Vision. (Cont.)
for measuring vision. These Tables, however, do allow the job analyst to do more with the visual requirements of jobs than he is able to do without a device to aid him in making reasonably accurate quantifiable judgments.

27. Near Vision. (43) The analyst also can determine the size of the most difficult object the job requires the worker to see at a close working distance. Then, by converting the size of the object into the equivalent size of printed type on a near vision chart, the analyst can approximate the near vision requirements of the job according to the charts.

Several different charts exist for measuring near vision, but they are copyrighted and therefore not shown here. They are, however, not difficult to purchase from optical companies or book stores. In the United States, the near vision chart often used is the Jaeger (arranged by Dr. Ziegler).

28. Color Vision. (44) Perceiving the color of objects by sight.

29. Depth Perception. (45) Perceiving distances of an object from the observer or from one object to another at different distances from the observer. This factor usually is required by most jobs involving machine operations and mobile equipment.

30. Hearing. (46) Perceiving the nature of sound by ear.

31. Talking. (47) Expressing ideas by means of the spoken word.

32. Other. (48--49) These are write-in spaces for any other physical factors the job analyst may encounter in rare instances, some of which are discussed briefly below and on the following pages.

a. Feeling. Although it is true that many jobs require the worker to perceive such attributes of objects as size, shape, temperature, or texture by means of the receptor nerves in the skin, the fact is that there is little practical value in recording this requirement for jobs because almost everyone possesses a sense of feeling. It becomes idle for the analyst to consider this factor when the physician almost never needs to.

b. Smelling and Tasting. Smelling and Tasting need not be considered by the analyst either. First of all, most people have a sufficient sense of taste and smell. Should an acute sense be needed, as in wine tasting, then it becomes a skill and a problem for the placement officer to determine rather than the physician.

TABLE F - 2

Visual Acuity Tables

SNELLEN VISUAL ACUITY TABLE

Object in Centimeters	Distance in Meters 1,5	3	6	12	18	24	30	60	90	120	150	300	600	900	1200	1500
0,6	21	9	5													
1,2	30	15	9	5												
1,9	60	21	12	6												
2,5	120	30	15	9	6											
5	180	60	30	15	12	9	6									
7,5	240	120	30	21	15	12	9	6								
10		120	60	30	21	15	12	6								
12,5		180	60	30	30	21	15	9	6							
15		180	60	30	30	21	21	9	6							
18		240	120	60	30	30	21	12	6							
20			120	60	30	30	21	15	9	6						
23			180	60	30	30	30	15	9	6						
25			180	60	60	30	30	15	12	9	6					
28			180	60	60	30	30	15	12	9	6					
30			180	60	60	30	30	21	12	9	6					
60			240	180	120	60	60	30	21	21	15	6				
90				240	180	120	120	60	30	30	21	12	6			
120					240	180	180	60	30	30	30	15	9	5		
150						240	180	60	60	30	30	21	12	6		
180							240	120	60	60	30	21	12	6		
210								120	60	60	30	21	15	12	9	6
240								180	60	60	60	30	15	12	9	6
275								180	120	60	60	30	15	12	9	6
300								180	120	60	60	30	21	12	12	6

MONOYER VISUAL ACUITY TABLE

Object in Centimeters	Distance in Meters 1	2	5	10	15	20	25	50	75	100	150	200	300	400	500	1.000	2000
0,5	0.3	0.6	1.5														
1	0.2	0.3	0.8	1.5													
2	0.08	0.2	0.4	0.8	1.5*	2.0	2.0										
3	0.06	0.1	0.3	0.5	0.8	1.0	1.5										
4	0.04	0.08	0.2	0.4	0.6	0.8	0.9	2.0									
5	0.04	0.06	0.2	0.3	0.5	0.6	0.8	1.5									
6	0.04	0.06	0.2	0.3	0.4	0.5	0.6	1.5	2.0								
7	0.04	0.06	0.2	0.3	0.4	0.5	0.6	1.5	2.0								
8	0.02	0.04	0.1	0.2	0.3	0.4	0.5	0.9	1.5	2.0							
9	0.02	0.04	0.1	0.2	0.3	0.4	0.5	0.9	1.5	2.0							
10	0.02	0.04	0.08	0.2	0.3	0.3	0.4	0.8	1.5	1.5							
12	0.02	0.04	0.08	0.2	0.2	0.3	0.4	0.7	1.0	1.5	2.0						
15		0.02	0.06	0.1	0.2	0.2	0.3	0.5	0.8	1.0	1.5	2.0					
20		0.02	0.04	0.08	0.2	0.2	0.2	0.4	0.6	0.8	1.5	1.5					
25		0.02	0.04	0.06	0.1	0.2	0.2	0.3	0.5	0.6	0.9	1.5	2.0				
30		0.02	0.04	0.06	0.08	0.1	0.2	0.3	0.4	0.5	0.8	1.0	1.5	2.0			
50			0.02	0.04	0.06	0.06	0.08	0.2	0.3	0.3	0.5	0.6	0.9	1.5	1.5		
75				0.02	0.04	0.04	0.06	0.1	0.2	0.2	0.3	0.4	0.6	0.8	1.0	2.0	
100				0.02	0.04	0.04	0.04	0.08	0.2	0.2	0.3	0.3	0.5	0.6	0.8	1.5	
150						0.02	0.04	0.06	0.08	0.1	0.2	0.2	0.3	0.4	0.5	1.0	2.0
200							0.02	0.04	0.06	0.08	0.1	0.2	0.3	0.3	0.4	0.8	1.5
250							0.02	0.04	0.06	0.06	0.1	0.2	0.2	0.3	0.3	0.6	1.5
300							0.02	0.04	0.04	0.06	0.08	0.1	0.2	0.2	0.3	0.5	1.0

SNELLEN VISUAL ACUITY TABLE
(Based on 5 Minute Arc)

Object in Inches	Distance in Feet 5	10	20	40	60	80	100	200	300	400	500	1000	2000	3000	4000	5000
1/4	70	30	15													
1/2	100	50	30	15												
3/4	200	70	40	20	15											
1	400	100	50	30	20	15	10									
2	600	200	100	50	40	30	20	10								
3	800	400	100	70	50	40	30	20	10							
4		400	200	100	70	50	40	20	15	10						
5		600	200	100	100	70	50	30	20	15	10					
6		600	200	100	100	70	70	30	20	15	15					
7		800	400	200	100	100	70	40	20	20	15					
8			400	200	100	100	70	50	30	20	20	10				
9			600	200	100	100	100	50	30	20	20	10				
10			600	200	200	100	100	50	40	30	20	10				
11			600	200	200	100	100	50	40	30	20	10				
In Feet:																
1			600	200	200	100	100	70	40	30	20	10				
2			800	600	400	200	200	100	70	70	50	20	10			
3				800	600	400	400	200	100	100	70	40	20	10		
4					800	600	600	200	100	100	100	50	30	15	15	
5						800	600	200	200	100	100	70	40	20	20	10
6							800	400	200	200	100	70	40	20	20	15
7								400	200	200	100	70	50	40	30	20
8								600	200	200	200	100	50	40	30	20
9								600	400	200	200	100	50	40	30	20
10								600	400	200	200	100	70	40	40	20

A. PHYSICAL FACTORS (Cont.)

32. Other. (Cont.)

c. Blowing. Blowing may be encountered rarely, as in the case of a glass blower. But here again this activity is more of a skill and need not be considered as a physical requirement.

d. Balancing. Balancing (like Breathing) is an implied factor and is an inherent part of many factors such as Standing, Walking, and Running. It need not be considered as a separate factor by the analyst. Moreover, from the physician's point of view, if a worker has poor balance for some reason, there is no need to indicate the worker's lack of balance by checking Balancing, but rather merely to restrict him from activities such as Climbing and working on High Places which might prove hazardous.

e. Dry Hands. Hands free from excessive perspiration. For those few jobs which require the worker to have dry hands, this factor may be recorded by the analyst under Other.

f. Working Speed. Occasionally, some job analysts believe it is necessary to write in Working Speed, that is, when a particular job requires an excessively high rate of speed. For the most part, however, this factor is rarely used since a decision as to when it should or should not be used is difficult to make. Moreover, when it is used, it implies that other jobs not so checked do not require speed, and this is not necessarily true. Because it is so difficult to draw the line, then, it is perhaps better not to use this factor. After all, every job requires some degree of working speed. In addition, speed requirements often fluctuate greatly.

B. ENVIRONMENTAL FACTORS

1. Inside. (50) Indoor protection from weather conditions.

2. Outside--Fair weather. (51) Out of doors or under an overhead covering with slight protection from the weather during stormless periods.

3. Outside--Wet weather. (52) Out of doors or under an overhead covering with slight protection from the weather during stormy periods.

4. Hot. (53) Temperature sufficiently high to cause perceptible bodily discomfort, usually found on jobs which require work around furnaces or fire.

5. Cold. (54) Temperature sufficiently low to cause perceptible bodily discomfort, usually found on jobs which require work in refrigerated rooms.

B. ENVIRONMENTAL FACTORS (Cont.)

6. Sudden Temperature Changes. (55) Variations in temperature which are sufficiently marked and abrupt to cause perceptible bodily reactions. Jobs which involve excessive heat or cold also invariably involve sudden temperature changes.

7. Humid. (56) Atmospheric conditions with moisture content sufficiently high to cause perceptible bodily discomfort.

8. Dry. (57) Atmospheric conditions with moisture content sufficiently low to cause perceptible bodily discomfort.

Hot, Cold, Sudden Temperature Changes, Humid, and Dry are to be considered by the analyst only when these factors are caused by conditions other than the weather itself. This is done because the weather conditions for a locality are usually a matter of common knowledge and hence no need exists for recording the seasonal temperatures for each job. An exception may be when an indoor job is performed in an unheated building in a locality where the winters are severe, or in a poorly ventilated building, where the summers are excessively warm. In such cases, the analyst should add a W or an S after the degrees of temperature recorded for Cold or Hot to show that the excessive temperatures exist only in winter or summer.

9. Moving Objects. (58) Exposure to moving equipment and objects such as overhead cranes, hand and motor driven vehicles, and falling objects which involves the risk of bodily injury; also the act of operating such equipment, as in driving a truck.

10. Hazardous Machinery. (59) Exposure to the moving parts of stationary machinery which involves the risk of bodily injury.

11. Sharp Tools or Materials. (60) Exposure to tools and materials with sharp edges which involves the risk of bodily injury.

12. Cluttered Floors. (61) Walking surface of workplace necessarily strewn with equipment, tools, or materials (not a condition of poor housekeeping), which involves the risk of bodily injury through tripping and falling.

13. Slippery Floors. (62) Walking surface of workplace which involves the risk of slipping and falling due to such agents as grease, oil, water, and polish, or due to wear as in the case of steel surfaces.

14. High Places. (63) Workplaces at an elevation above the floor or ground level from which it is possible to fall and be injured.

B. ENVIRONMENTAL FACTORS (Cont.)

15. Electrical Hazards. (64) Exposure to electric wires, transformers, bus bars, or other uninsulated or unshielded electrical parts or equipment which involve the risk of bodily injury, or general or fatal electric shock.

16. Exposure to Burns. (65) Workplace which involves the risk of burns from hot materials, fire, or chemical agents.

17. Explosives. (66) Exposure to explosive gases, vapors, dusts, liquids, and substances which involves the risk of general or fatal injury.

18. Radiant Energy. (67) Exposure to: (a) radio-Active substances such as radium, uranium, or thorium; (b) to X-Rays; or (c) to ultraviolet or infrared rays which involve the risk of impairment of sight or general or localized disabling conditions.

The analyst is to state the kind of radiation encountered on the job. If numerous kinds are found in a plant, it becomes necessary to make up a system for coding the various kinds found for recording on the Master Chart under the one heading of Radiant Energy.

19. Poor Lighting. (68) Illumination of workplace below the standards set by the Standards Association Code.

20. Poor Ventilation. (69) Air condition of workplace below the standards set by the Standards Association Code.

21. Toxic Conditions. (70) Exposure to harmful fumes, gases, vapors, mists, liquids, dusts, greases, or solids which may cause general or localized disabling conditions as a result of inhalation, ingestion, or absorption by the skin.

The analyst is to state the kind of toxic conditions found on the job. If numerous kinds are found in a plant, it becomes necessary to make up a system for coding the various kinds found for recording on the Master Chart under the one heading of Toxic Conditions.

22. Wet Quarters. (71) Workplace requiring contact with water or other liquid.

23. Close Quarters. (72) Workplace where freedom of movement is restricted or where the worker must maintain a stooped or cramped position.

24. Vibration. (73) Production of a quivering movement of the body muscles, particularly those of the legs and arms, as from repeated motion, pressure, or shock.

B. ENVIRONMENTAL FACTORS (Cont.)

25. Noise. (74) (a) Sufficient sound to distract workers engaged in "mental" occupations, such as sounds greater than those made by typewriters or other common office equipment. (b) Sufficient sound to cause possible injury to the sense of hearing of workers engaged in "manual" occupations, such as sounds from nearby chipping and riveting operations in a shipyard.

26. Working With Others. (75) Jobs requiring direct occupational cooperation with fellow workers or direct contact with the public.

27. Working Around Others. (76) Jobs requiring independent occupational effort but in proximity to fellow workers or the public.

28. Working Alone. (77) Jobs requiring independent occupational effort and virtually no contact with fellow workers or the public.

29. Shifts. (78) The work periods established by the plant for the job being analyzed, such as:

a. (D) Day Shift. Work period from approximately 8:00 a.m. to 4:00 p.m.

b. (S) Swing Shift. Work period from approximately 4:00 p.m. to midnight.

c. (G) Graveyard Shift. Work period from approximately midnight to 8:00 a.m.

30. Other. (79-80) There are write-in spaces for any other environmental factors the analyst may encounter in rare instances. Several examples are discussed briefly below:

a. Air Pressure. Force exerted by atmosphere or compressed air resulting in abnormally high or low air pressure. This factor, for example, is important for deep sea divers and personnel assigned to submarine duty.

b. Drafts. A movement of air which causes distressing bodily temperature changes. Although this is a poor definition technically speaking, it is perhaps a reasonably practical definition. Even so, it is doubtful that this factor should be considered in physical demands analysis work. Some workplaces may be drafty but the workers do not complain, while in other workplaces even the slightest draft will cause complaint. If drafts are to be judged, then they should be judged on the basis of complaint from a majority of the workers in the particular workplace.

B. ENVIRONMENTAL FACTORS (Cont.)

30. Other. (Cont.)

c. Underground. Workplace below the surface of the earth as in an underground mine, underground plant, or in other workplaces which are underground. However, when analyzing an underground mine or plant, the establishment already knows which of its jobs are underground and hence it is not so important for the analyst to record this commonly known fact. On the other hand, where plants have few underground jobs, there is justification for the analyst to write in "Underground".

d. Odors. Perceptible smells about the workplace. It is questionable that this factor should be considered. If the odor is a toxic fume, it will be covered under Toxic Conditions. If the odor is non-toxic then what may be a pleasant odor to one person might be distressing to a second person, and to a third, neither pleasant nor distressing. The analyst cannot rely on his judgment as being the same as others. Only if a majority of the workers agree that the odors about the workplace are unpleasant should the analyst record Odors.

e. Dirty. Dirty is a factor much like Odors. After all, what is dirty work and what is not dirty work? In broad terms, possibly all white-collar jobs are "clean jobs" and all others jobs are "dirty jobs". Yet, with such a concept, it becomes meaningless to indicate routinely that each white-collar job is a "clean job" and that each job other than a white-collar job is a "dirty job". Moreover, even jobs that all workers will agree are very dirty, are jobs often not minded by the particular workers who perform them.

Hanman's Five Forms For
Use In Application of The
Specific Method

FORM 1

Physical Demands Analysis Work Sheet

Job Title: .....

.....

Job Location: .....

Physical Factors:

	1	1— 5
	2	6— 10
	3	11— 25
	4	26— 50
	5	51—100
	6	100+

Lifting (Pounds) — Includes pushing and pulling effort while stationary

	7	1— 5
	8	6— 10
	9	11— 25
	10	26— 50
	11	51—100
	12	100+

Carrying (Pounds) — Includes pushing and pulling effort while walking

	13	R	Fingering
	14	L	
	15	R	Handling
	16	L	
	17	R	Reaching — Below Shoulders
	18	L	
	19	R	Reaching — Above Shoulders
	20	L	
	21	R	Throwing
	22	L	

	23	Sitting
	24	Total Time on Feet
	25	Standing
	26	Walking
	27	Running
	28	Jumping
	29	Climbing — Legs Only
	30	Climbing — Legs and Arms

	31	R	Treading — While Sitting
	32	L	
	33	R	Treading — While Standing
	34	L	

	35	Stooping
	36	Crouching
	37	Kneeling
	38	Crawling
	39	Reclining
	40	Twisting
	41	Waiting Time

	42	Seeing — Far — Snellen
	43	Seeing — Near — Jaeger
	44	Seeing — Color
	45	Seeing — Depth
	46	Hearing
	47	Talking
	48	Other: .....
	49	Other: .....

Environmental Factors:

	50	Inside
	51	Outside — Fair Weater
	52	Outside — Wet Weather
	53	Hot °F .....
	54	Cold °F .....
	55	Sudden Temperature Changes
	56	Humid
	57	Dry
	58	Moving Objects
	59	Hazardous Machinery
	60	Sharp Tools or Materials
	61	Cluttered Floors
	62	Slippery Floors
	63	High Places
	64	Electrical Hazards
	65	Exposure to Burns
	66	Explosives
	67	Radiant Energy (Kind): .....
	68	Poor Lighting
	69	Poor Ventilation
	70	Toxic Conditions (Kind): .....
	71	Wet Quarters
	72	Close Quarters
	73	Vibration
	74	Noise
	75	Working With Others
	76	Working Around Others
	77	Working Alone
	78	Shifts
	79	Other: .....
	80	Other: .....

Job Analyst's Name ..... Verified with: Foreman's Name ..... Date .....

FORM 2

MASTER CHART

PHYSICAL AND ENVIRONMENTAL DEMANDS

Numbers = Maximum Hours Required
+ = Required
E = Either Right or Left
Blank Spaces = Not Required

Job Titles — Job Locations — Job Numbers

Drill-Press Operator

Multiple Spindle

| | | |

Physical Capacities Report

Blank Spaces = Full Capacity
Numbers = Hours of Partial Capacity
0 = No Capacity

FORM 3

Name: Robert Olson | X Male | ☐ Female | Date of birth: May 22, 1907 | Height: 5'10" | Weight: 162

Remarks: (Diagnosis appears on physicians copy only. This worker's diagnosis is: ① Deaf mute.
② Right leg amputation below knee - fair prognosis ③ Rheumatic heart disease. ④ Arrested tuberculosis.
⑤ Nervous system exposed to noise and vibration.) Physician: A. Hoefelt Date: May 2, 1950

Physical Factors

-	1	1— 5	Lifting (Pounds) — Includes pushing and pulling effort while stationary
	2	6— 10	
1	3	11— 25	
0	4	26— 50	
0	5	51—100	
0	6	100+	
	7	1— 5	Carrying (Pounds) — Includes pushing and pulling effort while walking
	8	6— 10	
1/2	9	11— 25	
0	10	26— 50	
0	11	51—100	
0	12	100+	
	13	R	Fingering
	14	L	
	15	R	Handling
	16	L	
	17	R	Reaching — Below Shoulders
	18	L	
	19	R	Reaching — Above Shoulders
	20	L	
	21	R	Throwing
	22	L	
	23		Sitting
4	24		Total Time on Feet
4	25		Standing
2	26		Walking
0	27		Running
0	28		Jumping
1/2	29		Climbing — Legs Only
0	30		Climbing — Legs and Arms
0	31	R	Treading — While Sitting
	32	L	
2	33	R	Treading — While Standing
2	34	L	
	35		Stooping
0	36		Crouching
0	37		Kneeling
0	38		Crawling
	39		Reclining
	40		Twisting
	41		Waiting Time
20/30	42		Seeing — Far — Snellen
#3	43		Seeing — Near — Jaeger
	44		Color
	45		Depth
0	46		Hearing
0	47		Talking
	48		Other:
	49		Other:

Environmental Factors

	50		Inside
	51		Outside — Fair Weather
0	52		Outside — Wet Weather
0	53		Hot °F
0	54		Cold °F
0	55		Sudden Temperature Changes
0	56		Humid
	57		Dry
	58		Moving Objects
	59		Hazardous Machinery
	60		Sharp Tools or Materials
	61		Cluttered Floors
0	62		Slippery Floors
	63		High Places
	64		Electrical Hazards
	65		Exposure to Burns
	66		Explosives
	67		Radiant Energy
	68		Poor Lighting
	69		Poor Ventilation
P	70		Toxic Conditions
0	71		Wet Quarters
	72		Close Quarters
0	73		Vibration
0	74		Noise
	75		Working With Others
	76		Working Around Others
	77		Working Alone
1	78		Shifts
	79		Other:
	80		Other:

← Job Number

FORM 4

PHYSICAL QUALIFICATIONS REPORT

TO: MEDICAL DEPARTMENT DATE: May 2, 1950

FROM: PERSONNEL DEPARTMENT BY: F. Edebo

IS Robert Olson PHYSICALLY QUALIFIED
APPLICANT'S NAME

TO MEET THE PHYSICAL DEMANDS OF THE JOBS LISTED BELOW:

JOB NUMBER	YES	NO
123		V
127	V	
133	V	

5/2/50
DATE

A. Hedfeldt
EXAMINING PHYSICIAN

FORM 5

REQUEST FOR JOB ANALYST

To: PERSONNEL DEPARTMENT

From: .....
Foreman's Name

.....
Department Date

The physical and environmental demands of some jobs in this Department have changed recently.

Please send a job analyst to record the new demands.

DISTRIBUTION LIST

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